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THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

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COUNCIL ON DENTAL THERAPEUTICS

Accepted Dental Remedies

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Dentistry Goes Forward

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Vice President of the American Dental Association

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Original Communications

DENTAL CARIES: A REVIEW OF THE DEVELOPMENT OF THE CENTURY*

By FREDERICK B. NOYES, B.A., D.D.S., Sc.D., F.A.C.D., Chicago, Ill.

CARIES

WITH thirteen or fourteen articles appearing in the first two months of 1933 and almost every issue of each dental journal containing one or more articles on caries, it is, indeed, a bold undertaking to attempt to present a paper on this subject at this time. The average reader is bewildered by the variety of views and conflicting opinions presented; and because of this chaotic condition, it has seemed that the profession has been giving little thought to the subject and its relation to operative dentistry. It seemed possible that one who had been greatly interested in the work for a long time, but was not actively engaged at present in its investigations and who consequently was not obstructed in his view of the whole problem by the details of any investigation in progress, might more clearly see fundamental considerations. In harmony with the spirit of the Century of Progress Exposition, this paper is intended to review the development of the knowledge of this subject during the century.

For more than twenty years, I was intimately associated with the work of G. V. Black. During long hours with him in the laboratory, I believe that I came to know his views regarding the subject of caries and to understand the steps by which his knowledge was developed better than can be understood from a reading of his writings alone. Dr. Black was an unusually clear writer, but language often conceals rather than reveals the author's mind. Among the students of caries, Dr. Black stands alone in many ways: 1. This subject occupied his remarkably keen intellect as a principal interest for more than fifty years. This makes it seem bold indeed for some

*Read at the Seventy-Fifth Annual Session of the American Dental Association in conjunction with the Chicago Centennial Dental Congress, Aug. 9, 1933.

young doctor of philosophy, after a few months of investigation, to declare him entirely wrong in his opinions and conclusions. 2. Dr. Black was born at just about the time the cell theory of organic organization was being propounded. He was a student of biology during the famous discussions which established the continuity of life and which forever disproved the spontaneous generation of living things. He was a student of fermentation and its phenomena during the time in which Pasteur proved the agency of living forms in these processes. He was a student of bacteriology through the period of birth and development of this science, not simply as a reader, but also as a laboratory investigator following and demonstrating for himself each step in the growth of knowledge. He took an active part in the study and development of the germ theory of disease. In America, at least, he contributed more to the knowledge of the histologic structure of the dental tissues than did any other man. All of these facts gave him a grasp of the fundamental concepts which make his writings today the marvel of the studious reader. For instance, it is amazing to find him writing in 1880 that there is

> . . . an organism which has one period of development in the human body and another period without the human body and that these two stages are required for its full development. Therefore such diseases are not contagious; they cannot pass from one to another until they have found a suitable soil for the second period of development. When this has been accomplished they are again ready for the production of the disease in man and not before. In this way whole regions of the country become infected and persons are struck down with the disease without having seen one sick of it or having been near them. . . . Yellow fever belongs to this class.[1]

This was written nearly a quarter of a century before the rôle of the mosquito in yellow fever contagion was demonstrated. It seems today that many investigations which are being conducted by men with enormous detailed knowledge in a narrow field fail to be of the value expected because of lack of broad fundamental concepts. 3. Dr. Black was always both a clinician and an ininvestigator. During the entire time that he was studying caries in the laboratory, he was also studying caries in the mouth, and it was his observations of the patient which drove him to the laboratory for explanations. He was for many years in private practice, studying the phenomena of caries in the same individuals throughout their lives. I remember in one place his statement that he had followed the phenomena of the disease in many instances through four generations. In the last twenty years of his life, with this background of private practice, he had the opportunity of studying caries in a great city clinic. I have often felt that the investigator studying in the clinic without the background of private practice is at a great disadvantage. In private practice, the same individuals are followed year after year. In the clinic, great numbers of patients come and go, but to follow them year after year is very difficult and requires expensive organization. 4. Dr. Black was born on a pioneer farm and grew up in the environment of the frontier. Under these circumstances, close observation and correct deduction were imperative. To recognize or fail to recognize the difference between the imprints of an Indian's and a white man's moccasin meant life or death. I have studied under many famous scientists, but I have never known one who out of a series of recorded observations could pick the significant ones with the unfailing certainty of this great investigator. 5. Be-

1. Black, G. V.: Formation of Poisons by Micro-Organisms, Philadelphia: P. Blakiston, Son & Co., 1884, p. 46.

cause of his clinical contact and the breadth of his interest, Dr. Black's studies of caries followed each other in logical sequence.

I have set myself the task of following the development of Dr. Black's knowledge of caries, step by step, as it grew. This is material for a volume, and it requires temerity to attempt it in thirty minutes. When Dr. Black entered the practice of dentistry, the two conflicting theories of caries were the vital theory and the acid theory. The vitalist held that the tissues of the tooth broke down and were destroyed by a process beginning within the tooth which was in some way similar to the breaking down of tissues in inflammation. The acid theory maintained that the teeth were destroyed from without by acid attacking the surface. On page 149 of "Formation of Poisons by Micro-Organisms," Dr. Black summarizes the observations and facts which settle for him forever the vital theory of caries. We read:

> It was observed that artificial teeth, constructed of ivory, bone, sheep's teeth, and human teeth, were as liable to caries as the natural teeth; and that this decay was, to all appearance, the result of similar, if not precisely the same causes. This, of course, could not be the result of vital forces existing in the structure undergoing the process of decay. The conditions of the decaying portions were very closely studied, to see whether or not anything could be discovered that would show that these processes were essentially different from each other. Some differences were found, but the more they were studied the more evident did it seem that these differences were not of such a nature as to show that the processes were in any wise distinct from each other. These studies caused the abandonment of the vital theory; for, if dead substances decayed the same as living ones, the forces which bring about the result must be other than the vitality of the suffering organ, and therefore cannot be the result of inflammation; it must be some force external to the tooth, something which attacks the tooth from without. This point seems to have been very thoroughly established, and we supposed it was well settled in the minds of all modern thinking men. But, curiously enough, the old notion has recently been revived by certain gentlemen in New York. The effort to maintain such an hypothesis, however, must inevitably result in failure; for in it there is a plain want of consideration of the known facts of the subject. It need not, therefore, detain us longer.

The source of the acid which attacks the surface of the tooth was the next focus of interest. The fact that caries occurred only at certain points on the surface of the enamel and not over the entire surface of the teeth and the observation that caries was very active in many mouths in which the saliva was habitually alkaline excluded, for him, the saliva as the source of the acid. His knowledge of fermentation led him naturally to the hypothesis that it was the formation of acid by a process of fermentation from food débris lodged at points of protection that was the cause of the destruction. This led to the question: Could these supposedly weaker organic acids which are produced by the processes of fermentation dissolve as hard a substance as the enamel of the tooth? In 1868, Magitot published his classic experiment on this subject. Of this, Dr. Black writes, on page 155 of "Formation of Poisons by Micro-Organisms": "This series of experiments showed that most of the organic acids act very feebly on the teeth in proportions of one to one thousand or more and that in proportions of one to one hundred they act quite energetically so that teeth submitted to their action will be completely decalcified within a few weeks or months." It is interesting to note that although Dr. Black repeated all of these experiments, he was content simply to refer to the publication above.

In the seventies, then, Dr. Black considered caries to be caused by the decom-

position of food débris lodged in protected places about the teeth through the agencies of living organisms. I want to call attention to the fact that this is still referred to as the theory of Miller and Black. It is to be found again and again in the articles written within a year. I shall point out later that Dr. Black changed this concept most fundamentally in the early years of this century. He did not change his basic concept that the acids are the result of fermentation. He describes most beautifully, on page 153 of "Formation of Poisons by Micro-Organisms," the result of this acceptance and the change from the acid theory to the germ theory of caries.

> The manner of the production of this acid has been a subject of much inquiry. All, I believe, admit that it must come in some way through fermentation or decomposition; at any rate, through a remoleculization of the substances lodged about the teeth. This leads directly to the discussion of the much vexed question of the fermentations and decompositions, and the relations of the life force thereto. The research of the last few years leaves but little doubt on this point. These processes are the result of the activity of living organisms. The teachings of Liebig on this subject may now be regarded as disproved. With this point settled, the old acid theory glides easily into the new germ theory, and we may recommence our studies from the new standpoint we have gained, carrying with us all the facts that have been developed to guide us on our way.

In the early eighties, W. D. Miller published a series of articles which definitely established caries, at least of the dentin, as a germ disease. Speaking of this work, Dr. Black says: "One of the noblest pieces of scientific work in pathology was Dr. W. D. Miller's investigation of dental caries. It not only developed the question at issue but completed the investigation so that the rest of us in repeating his experimental work could only say, 'Well and correctly done.'" In another place, Dr. Black quotes from Dr. Miller's first article as follows: "During the last two years I have stated at different times and places as the result of my experiments that the first stages of dental caries consists in a decalcification of the tissues of the teeth by acid, for the greater part generated in the mouth by fermentation. The object of the investigations described in this and the following papers is to determine this ferment and the conditions essential to its action."

It is needless now to review the steps in this demonstration. They were essentially the isolation of an organism from carious dentin without danger of contamination from the mouth; the growing of this organism through repeated series of generations, proving its identity and biologic continuity, and the production of caries of dentin in the test tube by this micro-organism. It is important to emphasize that the enlargement of the diameter of the tubules is one of the characteristics of carious dentin and that this is produced by the digestive ferments of the organism, not by the acid. Dr. Miller showed that caries-producing organisms make a good growth on sterilized decalcified dentin without other culture mediums. This is emphasized because many modern investigators have lost sight of the fact that the bacteria of caries have other powers besides the formation of acid or that the formation of acid is in the nature of a byproduct in the activity of the organism. This demonstration of Dr. Miller's had great importance in the development of the germ theory of disease. It is hard for us to think in terms of the knowledge of the eighties, but the germ theory was attacked by the standpatters with the contention that the diseased tissue produced the germs, not the

germs the disease in the tissue. A lung or a liver could not be removed from the body and the lesion produced in it, but Dr. Miller removed the tooth from the body and reproduced the disease in it. It may therefore with reasonable fairness be said that caries of the teeth was the first disease in which the germ theory was completely and logically established. In view of these facts, it is strange to see Percy R. Howe publishing this statement: "Decay of the teeth is not, as many people believe, caused by bacteria. It is a form of bone degeneration resulting from improper food, food lacking in mineral salts and the mysterious vitamin C."

The work of Dr. Miller was so well organized, so thoroughly worked out and so clearly presented that from 1885 to 1895, it was generally accepted, and there was a lull in the laboratory investigation of caries. During this time, Dr. Black continued in private practice. He was not only a keen observer and careful student of his patients, but he also kept accurate clinical records. From these records, he gradually arrived at certain well established clinical facts. First, he observed that caries follows a certain definite order of attack. It appears (1) in the occlusal enamel defects of the temporary molars; (2) but more rarely, on the proximal surfaces of temporary incisors; (3) on the occlusal enamel defects of the first permanent molar; (4) on the proximal surfaces of temporary molars. As the permanent teeth erupt, enamel pits and fissures are the first to suffer. Later the gingival third, especially of labial and buccal surfaces, and finally the proximal surfaces in the regions protected by the contact points are affected. He studied these areas of liability to caries with reference to the anatomic forms of the teeth and the relation of the teeth in occlusion. From these studies, he recognized habitually susceptible and habitually immune areas and the relation of these areas to the excursions of food in mastication. In one place, he states that it may be affirmed without danger of contradiction that 98 per cent of beginning caries occurs in these susceptible areas. In another place, he says: "As the result of recorded observation of ten thousand cases, in not over one case in a thousand did caries extend around the angle from one smooth surface to another."

It is impossible here to review all of the facts, but upon such clinical observations was based his principle of extension for prevention. This may be briefly stated as follows: If in the preparation of cavities for the treatment of caries, the cavity margin is laid in an area of the tooth surface habitually immune to the beginnings of caries and the filling is properly made and finished, the tooth is less liable to a new attack than it was originally. The formulation of this doctrine changed the filling of teeth from a mechanical restoration of the lost part to a therapeutic measure in the treatment of a disease. It marks one of the most important milestones in the development of dentistry as a profession.

In his continuous care of families, he noted that caries is essentially a disease of childhood and that children susceptible to other germ diseases are also especially susceptible to caries. He found that most individuals become immune to the beginnings of caries with maturity and that, after that time, new cavities that develop usually have had their beginnings during the susceptible period. He noted periodic returns of susceptibility when there would be new beginnings of caries on the surface of the enamel and the fact that this might be followed again by immunity. During these years,

a large number of young Norwegian women came into the middle west and began life as house servants. When they arrived, they had beautiful teeth, apparently of fine quality, but, in their new environment, the teeth were destroyed with tremendous rapidity by caries. Again, he observed instances in which all of the teeth were poorly formed and of poor quality and no caries developed over long periods of observation.

During the period from 1880 to 1890, the opinion grew in the profession and among the laity that liability to caries was determined by the quality of the teeth; that soft or poorly calcified teeth were susceptible, while hard and well calcified teeth resisted the disease. This did not agree with his clinical observations, and about 1895, he published the results of a long series of investigations of the physical and chemical character of the tooth tissues. In these, he was able to demonstrate no correlation between the percentage of lime salts in the tissues and the occurrence of caries. Teeth from individuals highly susceptible to caries were as well calcified as those from immune individuals. It is true that chemical methods in those days were not so accurate as they are today, but the same methods would show correlation if present. The clinical and laboratory methods together convinced Dr. Black that the structural and chemical perfection of the tooth was not a primary factor in dental caries.

During the first decade of the present century, Dr. Black carried on a new intensive study of the beginnings of caries and of the effects of the disease on the structure of the dental tissues. This work constitutes one of his greatest contributions to dentistry and, by it, some fundamental concepts were profoundly altered. For the prosecution of this work, he devised and constructed a machine for the cutting and grinding of tooth sections both for macroscopic and for microscopic study. This machine made possible the preparation of specimens which could not have been made before, and by its use he was able to demonstrate the progress of caries from its earliest beginnings to the complete destruction of the crown. As a result of this work, he no longer considered caries to be caused by the decomposition of retained food by acid forming bacteria, but to be due to the growth of a colony of acid forming bacteria firmly attached to the surface of the enamel. I wish to emphasize this change of opinion very strongly; first, because I know that it was very clear in his own mind and, secondly, because it seems to have entirely escaped the understanding of modern investigators. I find not a single recognition of it in the reports of researches even of the last few years. There is a profound difference between considering that caries is caused by the lodgement of food débris which is later decomposed by acid forming bacteria, and recognizing that it is caused by the lodgement and attachment of a colony of bacteria to the surface of the enamel. The colony produces materials which prevent the dilution of the acid by the saliva and confine the acid to the surface of the tooth, which immediately reacts to it. This is very clearly stated in a number of places:

> It may be laid down as a fundamental principle that caries to begin in the enamel of the teeth anywhere, the caries fungus which forms an acid must be attached to the surface of the enamel in some such way as to prevent the acid which is formed from being readily washed away and dissipated in the general fluids of the mouth. . . . In the consideration of the beginning of caries in the enamel with reference to treatment, it may be stated as a fundamental postulation that the nidus of each beginning of

caries will be found at that particular point at that surface of tooth attacked or that may be attacked in the future that offers the best position for the lodgement and undisturbed growth of colonies of microorganisms.

There is a very significant difference between these statements and his concepts in 1870-1880. During the last fifteen years of his life, he was continuously endeavoring in the laboratory to discover the means by which colonies became adherent to enamel surfaces and their acid products confined. He was able occasionally to make cultures in broth which produced colonies that would become so firmly attached to the surface of the glass that they could be removed only by scraping, but he was never able to determine by what means this was produced or what materials were formed to accomplish the results. He recognized that in different colonies growing on the surface of the enamel, there were varying degrees in the perfection of this confinement and that this governed the intensity of the attack. In the last lecture on caries that I heard him give, he pointed dramatically to the white spot at the contact point of an incisor and said, "By what power was the acid confined upon that spot?" In his mind, the answer to that question contained the answer to the problem of susceptibility and immunity to dental caries; and the work since 1914 has not answered the question.

During the last decade of the last century, J. Leon Williams demonstrated the presence of bacterial colonies, bacterial plaques, as he called them, adherent to the surface of the enamel in the beginning of caries of the enamel. He prepared ground sections of teeth with these bacterial colonies in place. It was this work of Dr. Williams that stimulated Dr. Black to undertake the study of the beginning of caries on the enamel surfaces. He realized that to prosecute this study, he must be able to grind large numbers of sections and that the development of a grinding machine was a primary requisite. In characteristic fashion, he started out to master the technical difficulties before attacking the problem. It was necessary not only to construct this machine but also to work out new technical methods in the preparation of the specimen. I know full well the enormous amount of time that was spent in this preliminary effort for the new attack.

He had been studying for years the clinical appearance of beginning caries. Now he watched the extracting room, and whenever a tooth was removed that showed the marks of beginning caries, he pounced upon it for his laboratory study. He had at this time the advantage of a very large clinic, which gave him the opportunity for the collection of an enormous amount of material. I know, for I photographed them, that he had for every specimen that he published dozens of duplicates. He never repeated the work of Williams because he considered the demonstration perfect and so not demanding repetition, but more because his preparations showed perfectly the extent and character of the colony by its effect on the tissue and thus it was not necessary. His demonstration of what occurs in the progress of caries was complete and was worked out in such detail and proved by such incontestable evidence that it constitutes his greatest personal contribution to the study of caries. Because this work was never properly assimilated by the profession and because it has been completely lost sight of by most modern investigators, it seems important to state it with some detail.

First, Black distinguished constant characteristics in the beginnings of caries in pits and fissures which made a sharp contrast with beginnings on smooth surfaces. In pits and fissures, these defects must be considered as infoldings of the surface of the tooth, and while the depth of the defect is at some distance from the general surface of the tooth, caries beginning at this point must still be considered as an attack from the surface, the start being from without and progressing inward. I am speaking of this because it has led to some misunderstanding. In defects of this character, the colony occupies the whole of the space, but it is unable to spread upon the whole surface of the tooth at the margin of the defect because of the attrition of food in mastication. For this reason, the confinement of acid is most nearly perfect in the depth of the defect and here progresses most rapidly. The acids first attack the cementing substances between the rods and follow the rod directions toward the dental enamel junction, producing a cone shaped area of disintegration of tissue with the apex toward the opening of the pit and the base toward the dental enamel junction. As soon as the solution of the cementing substance reaches the dentino-enamel junction, decalcification of the dentin matrix begins, following the dentinal tubules toward the pulp and spreading through their branches at the dentino-enamel junction. At this stage of development, there appear two cones of partially disintegrated tissue with their bases at the dentino-enamel junction. In the enamel, the apex is toward the opening of the defect; in the dentin, toward the pulp. In these positions, the intensity of the destruction of the enamel is usually greater than in other positions, and for that reason the enamel rods at the depth of the defect are often rapidly destroyed. As soon as this occurs, the micro-organisms of the colony are admitted to the dentin and grow into the dentinal tubules, following their direction toward the point and through their side branches, especially at the dentino-enamel junction. The decalcification of the dentin matrix is always in advance of the micro-organism.

As soon as the micro-organisms are admitted to the dentin, their enzymes produce liquefaction of the matrix, enlarging the diameters of the dentinal tubules. In this way, the micro-organisms use the decalcified dentin matrix as a culture medium. In general, the smaller the opening of the pit, the more rapidly the process progresses in the dentin, and the entire crown may be destroyed without any breaking through of the enamel or any extension on the surface. For this reason, Black strongly emphasizes that all such positions should be discovered and filled as soon as the decalcification reaches the dentino-enamel junction and, that if they are properly filled, there will never be a recurrence. I have seen many such gold fillings of my father's that had remained until the occlusal enamel was entirely worn through by abrasion. Often, in such positions, the formation of acid by the bacteria in the dentin will be sufficient to cause backward decay of the enamel, dissolving first the cementing substance, following the rod directions and progressing until a portion of the occlusal enamel breaks in. I still have a large number of negatives that show all stages in this process.

Caries beginning upon smooth surfaces presents a markedly different character. Very soon after a colony becomes attached to the surface, dissolution of the cementing substances around the rods begins, and this follows the rod directions

toward the dentino-enamel junction. As the colony spreads from its point of attachment, the attack on the surface begins. The colony thickens as it spreads and, consequently, the dissolution of cementing substance progresses most rapidly at the point of beginning. In this way, a cone-shaped area of disintegrated enamel is produced at the base of the cone corresponding to the periphery of the colony, the apex opposite the point of beginning. In these positions, the dissolution of cementing substance is usually much more rapid than the dissolution of the rods, and large areas of disintegration may be produced without destroying the surface of the enamel.

As soon as this process reaches the dentino-enamel junction, the dissolution of the dentin matrix begins, progressing most rapidly at the dentino-enamel junction, through the branching of the dentinal tubules and proceeding toward the pulp, following the tubule direction. In this condition, there is a cone of disintegrated enamel with its base at the surface and its apex at the dentino-enamel junction and a cone in the dentin with its base at the dentino-enamel junction and its apex toward the pulp. Dr. Black showed conclusively that, during this period, the colony was maintained upon the surface of the enamel and bacteria did not penetrate the tissue until the enamel rods were destroyed or fell out.

If the colony of bacteria on the surface is dislodged before the disintegration of enamel reaches the dentino-enamel junction, the spaces in the disintegrated enamel are saturated with fluids from the mouth and organic materials are deposited in these spaces. By this process, the whitened area becomes dark. Such darkened areas always indicate arrested caries, and these areas become more resistant to acid than sound, unaffected enamel. The recent work of Enright and Friesell[2] has supported this and, for the first time, given evidence of the reason for the reaction.

By this process, the rods in a considerable area may become so loosened that the surface of the enamel bulges, the area of protection increasing and the colony extending farther on the surface of the tooth. As soon as the rods of the central area fall out, the micro-organisms are admitted to the dentin, but not before. As soon as this occurs, the protection of the colony at the point of beginning is lost and surface extension may stop, but the process proceeds in the dentin with increased vigor and the undermining of the enamel may cause breaking in of the crown as in the case of the occlusal defect. The extent of the area of enamel which may be disintegrated by caries without the production of a cavity was a great surprise to Dr. Black, as it will be to all who will repeat this work.

It was the observation of this disintegration of tissue that led him to emphasize so strongly in the last years of his life that, in the treatment of caries, cavities should be filled at their beginning rather than in their burrowing stages and that cavity margins should be so laid after a study of all the phenomena presented as to prevent recurrent attack. Only in this way can unnecessary destruction of tooth tissue be avoided, the recurrence of decay be prevented and the vitality of the pulp be insured. Extension for prevention was with him not an arbitrary rule to extend all proximal cavities in molars and

2. Enright, J. J., and Friesell, H. E.: Studies of Cause and Nature of Dental Caries, J.A.D.A., 20:897 (May) 1933.

bicuspids to a width two-thirds the buccolingual diameter of the crown, but a study of the manifestation of caries in the mouth taking all factors into consideration and laying the cavity margins in such positions that the tooth would be less liable to caries than it was originally.

In this view, operative dentistry becomes not a technical procedure but a therapeutic measure calling for the most careful study of the disease manifested in the individual and bringing that individual one step nearer the attainment of a continuing immunity. This calls for the highest qualities of professional knowledge, judgment and skill and makes operative dentistry not a tedious repetition of technical operations but a challenge to all of a man's faculties. He and many men who practiced his teachings saw many individuals for whom they had throughout childhood and youth carried on this fight against caries arrive at the immunity of adult life without having lost a tooth or a filling. I have in my possession a letter to my father from a dentist in Philadelphia about a patient for whom my father had carried through such a fight. Much later in life, this patient had come into this Philadelphia dentist's care, still with a perfect denture.

In recent years, the slogan "A clean tooth never decays" has been attacked and ridiculed, but no one yet has been able to demonstrate that caries ever occurs without the lodgement and growth of a colony of bacteria on its surface. However free of food débris it may be, a tooth cannot be called clean with a colony of acid-forming bacteria adhering to its surface.

A review of Dr. Black's contribution to our knowledge of caries would be grossly incomplete without some reference to his concept of immunity. Discussing this subject he says[3]:

> While caries of the teeth is the most prevalent disease known to man, those in dental practice who have not made a careful study of the teeth of persons who have no need for dental operations perhaps do not realize how many are immune to caries of the teeth. Many grow up from childhood and pass on to old age without ever having a carious tooth. These persons are always to be found if you will look for them.
>
> In the mouths of these persons the same micro-organisms are found growing and growing as abundantly as in the mouths of persons who are very susceptible to caries. . . . Cultures of micro-organisms from these immune persons have been made over and over again and it has been found that these micro-organisms are of the same character and species and produce the same results in culture media as do micro-organisms taken from the mouths of those who are very susceptible to caries. Some of these persons have been followed for years, occasional examinations and cultures being made so as to leave no possibility of doubt as to the general facts. Therefore, there is something lying over beyond the active growth of micro-organisms and acids formed by them controlling caries of the teeth. We have, therefore, persons who are pre-disposed to caries of the teeth and persons who are immune to caries of the teeth.

He recognized that immunity to caries, like immunity to other diseases, must have a material basis and consequently that it could be found. He recognized also that it had a strong hereditary factor, for he had followed immunity and susceptibility running consecutively through four generations. He found also that, under changed environments, immunity might be lost. His concept of the matter was that in immunity to caries as in immunity to other germ diseases, there must be substances present in the organism which modify the activity of bacteria; that in immune in-

3. Black, G. V.: Operative Dentistry, Chicago: Medico-Dental Publishing Co., 1908, Vol. 1, p. 115.

dividuals, although caries fungus was present in the mouth, it was unable to form colonies which attached themselves to the surfaces of the teeth and confined the acid to the point of its formation. His previous clinical and laboratory experience did not lead him to look for this in changes in the tooth tissues or to expect it from the control of diet except as diet might affect the general conditions of the individual.

A paper presented before the Illinois State Dental Society in 1868 (?) to which Dr. Black refers on page 165 of "Formation of Poisons by Micro-Organisms" is of particular interest in consideration of the publications of some recent investigators. In this paper, Dr. Black describes the disintegration of enamel and tooth tissues by pathologic tissue fluids in unerupted and partially erupted teeth, but he clearly differentiates this from caries.

After Dr. Black died, a great number of divergent and inharmonious views developed, as is usual when a dominating figure drops out of a field of scientific work. Many of the old theories came back to life: the vital theory, the hard and soft tooth theory, the acid saliva theory have all found their champions. The discovery of the vitamins suggested controlling factors, and Mellanby has ascribed dental caries to deficiency of vitamin D; Howe, to deficiency of vitamin C. The work on vitamins and diet has given us much information in regard to the formation and calcification of dental tissues, but there was already an abundance of evidence that perfection of calcification and structure was not the determining factor in dental caries.

It is difficult to discuss the work of the vital theorists. They maintain their hypothesis by positive statements which are not supported by adequate evidence. In much of this vital theory work, it seems that there is a lack of appreciation of fundamental biologic concepts. The student of dental histology and pathology cannot escape pitfalls unless he maintains clear concepts of the fundamental relation between cells and intercellular substances, between living cytoplasm and formed materials. To attempt to ascribe to vital resistance of enamel the control of bacterial action is at variance with all of the recognized facts of life. The opinions of the vital theory school have been so voluminously propagated and so continuously presented to the profession that they have gained a considerable foothold.

It has seemed that much of the experimental work on diet has been too far detached from the study of caries in the human mouth. The rat is an animal normally immune to caries and to produce "holes in his teeth" that look like caries by feeding him abnormal diets seems unlikely to give us information that will be of value in treating or combating the disease.

The control of the diet of children in large groups, as for instance in orphanages, presents the most hopeful attack on the relation of diet to dental caries, but most of the work so far has not been sufficiently controlled or carefully enough executed to produce reliable results. The noting of new cavities and the estimating of the increase in size of old cavities cannot give a satisfactory estimate of susceptibility and immunity. The thing which must be determined is: Are there new attacks occurring upon the surface of the enamel? Cavities which have reached the dentin will progress slowly even in immune mouths, and cavities involving the dentin that are wide open to the fluids of the mouth tend to advance more slowly

even in susceptible mouths in which there are new beginnings upon the surfaces. That a properly balanced diet tends to reduce the incidence of caries in susceptible individuals seems already fairly well established, but a significant remark was made in a recent discussion by a person who has been in charge of one of the most extensive diet control experiments that have been carried out. This person said in substance: "The true caries-immune individual does not manifest caries no matter what you feed him, and no matter what the diet of the caries-susceptible, caries is not *entirely* eliminated." This takes me back to Dr. Black's statement that, in the immune individual, there is some material constituent in the fluids or tissues in the body which prevents the bacteria from producing the phenomena of the disease.

Recently, the Vienna group have advanced the hypothesis that the presence of the secondary dental cuticle, because it is resistant to acids, is a factor in the resistance to the beginnings of caries. In this, they lose sight of fundamental properties of bacteria. While these horny cells are resistant to acid, they are not sufficiently resistant to be preserved from destruction by bacterial enzymes.

I do not wish to depreciate the value of the great amount of work that has been done in the last eighteen years. It is only by attacking the problem from all angles and at the expense of an enormous amount of fruitless effort that advancement is obtained, but the publicity given to imperfectly worked out experimentation and unsupported hypotheses has retarded rather than advanced the efforts of the dental profession to combat caries. We may well close with Dr. Black's words: "We may recommence our studies from the new standpoints we have gained, carrying with us all the facts that have been developed to guide us on our way."

BACTERIOLOGIC AND IMMUNOLOGIC STUDIES ON DENTAL CARIES*

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THE method by which caries attacks the tooth has been the subject of much controversy, and a variety of theses have been advanced to explain this puzzling process. It is not the purpose of this paper to go into a detailed discussion of all the phases of dental caries. We intend only to consider the bacteriology and immunology of the disease.

One characteristic of this disease is perfectly obvious. There is universal agreement that a primary decalcification of the enamel or cementum is the initial stage in the process and precedes the destruction of the remainder of the tooth. This fact has long been recog-

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nized, and even the earliest investigators sought for the conditions in the mouth that could bring about the destruction of these tissues.

The discoveries of Pasteur stimulated research and served to focus attention on a possible relationship of bacteria to dental caries. Leber and Rottenstein[1] described micro-organisms associated with dental caries and were particularly impressed by the leptothrices. Underwood and Milles[2] advanced the chemico-parasitic theory of the disease. It was demonstrated that caries of the enamel could be produced *in vitro* by subjecting enamel to the action of acids. It was concluded, therefore, that this was the manner in which the teeth were destroyed *in vivo* and that the acids essential to the process were provided by organisms which abound in the mouth. The literature is replete with interesting accounts of the pioneering of Leber and Rottenstein, Underwood and Milles, Magitot,[3] Miller[4] and Black,[5] and there is no necessity for a review of their investigations in this paper.

Miller's fermentation studies on the saliva were perhaps the most notable, constituting a simple and direct attack on the problem, and the results obtained definitely fixed the responsibility for the carious process on bacterial activity. Many of Miller's contemporaries did not regard bacteria as a factor in dental caries and stoutly maintained that the bacteria were the result rather than the cause of fermentation. They did not recognize the fact that bacteria are able to utilize the carbohydrates in the mouth to produce acids capable of decalcifying the enamel.

The findings of Miller have been repeatedly corroborated by more recent workers and are accepted today substantially as they were written fifty years ago. Although Miller recognized many acidogenic bacteria in the oral flora, he did not single out any particular organism as the specific cause of dental caries.

Goadby[6] concurred in the belief that bacteria were responsible for the production of the acids of dental caries. He emphasized the fact that if the disease were due to a generalized acidosis of the saliva, caries would be more symmetrical, more general and more severe than it usually is. Goadby differentiated between two types of dental caries: the rampant, which affects many teeth in the mouth, and the slowly progressing type, which might attack only one tooth. These two types, according to Goadby, presented a different bacteriologic picture, the proportion of organisms fermenting carbohydrate in the first being forty times that of other oral bacteria. In mouths free from dental caries, organisms of putrefaction predominated, there being present only a small number of types capable of producing acid from carbohydrates. Among the acid producers, he named staphylococci, streptococci, bacilli of the lactic acid group, yeasts and an acid-producing bacillus which grew in chains which he designated as *Bacillus necrodentalis*.

As a prophylactic measure, Goadby suggested that a careful survey be made of the mouth to determine the predominant bacterial types. As the carbohydrate fermenters prevailed in the caries-

1. Leber, Theodor, and Rottenstein, J. B.: Ueber d. Caries der Zahne, Berlin, 1867.

2. Underwood, A. S., and Milles, W. T.: Tr. Internat. Med. Cong., p. 523, 1881.

3. Magitot, Emile: Recherches sur la Carie des Dents, 1871.

4. Miller, W. D.: Micro-Organisms of Human Mouth, Philadelphia: S. S. White Dental Mfg. Co., 1890.

5. Black, G. V.: Operative Dentistry, Vol. 1, Chicago: Medico-Dental Publishing Co., 1908.

susceptible cases, he suggested that the mouth be inoculated with organisms of the mesentericus type which would produce an alkaline reaction and other products "inimical to acid fermenters." He stated that, in his hands, very promising results were obtained by this method. Included in this procedure was the use of a slightly acid mouth wash. Commenting on the use of the acid mouth wash, Stokes,[6] in his discussion of Goadby's paper, remarked that it should be used with caution since many people who were drinking "sour milk" for digestive disturbances had noticed an increase in the tendency of their teeth to decay. No mention was made of the method of preparation of the "sour milk." Though we know that the use of an acid mouth wash is not likely to induce true dental caries, it would be interesting to know whether the milk was of the acidophilus variety. In the light of more recent investigations on *Bacillus acidophilus,* these statements are interesting. We hear occasional reports of an outcrop of dental caries associated with the use of acidophilus milk. We will show later that there is no experimental evidence to support this belief, as *B. acidophilus* may not necessarily be implanted in the mouths of caries-free individuals by ingestion of even large doses of that organism.

Kantorowicz[7] also found *Bacillus necrodentalis* associated with caries, but found these bacilli to be less numerous than the streptococci in the deeper layers. Kantorowicz, Becker,[8] Baumgartner[9] and Goadby, in his later work, believed the streptococci to be of greater significance than the bacilli in the etiology of dental caries.

Kligler,[10] to the contrary, demonstrated very clearly that the streptococci were normally present on healthy teeth. They were present in greater numbers in unclean mouths, but the type of flora was the same regardless of the state of cleanliness in all mouths in which the teeth were not carious. In mouths in which caries was active, the nature of the bacterial flora changed very noticeably. The coccal forms dropped into the background and acid-producing bacilli were found to predominate. To quote Kligler directly: "For the present, it is clear that the early stages of caries are bacteriologically due to one and the same process, characterized by a great increase in the total number of bacteria, accompanied by a drop in the relative number of cocci, and a marked increase in the number of acidific and thread forming organisms."

In caries which involved the pulp, he found the total count to be much lower, with a drop in the relative number of cocci, a disappearance of the thread forms and the presence in all cases of anaerobic putrefying bacilli. The aciduric bacilli persisted in practically the same numbers as in initial caries. Kligler also called attention to the striking similarity between the aciduric rods which he isolated from caries and Goadby's *Bacillus necrodentalis,* both of which were identical with Moro's *Bacillus acidophilus.*

Howe and Hatch[11] confirmed the findings of Kligler, as they found *Bacillus acidophilus* present in all cases of caries.

6. Goadby, Kenneth: Brit. M. J., 2:769, 1910.

7. Kantorowicz, A.: Bakt. u. Hist. Studien über die Caries des Dentins, Leipzig, 1911.

8. Becker, Joseph: Deutsche Monatschr. f. Zahnheilk., 41:308, 1923.

9. Baumgartner, Erich: Wien. Klin. Wchnschr., 26:178, 1913.

10. Kligler, I. J.: J. Allied D. Soc., 10:141, 282, 445, 1915.

11. Howe, P. R., and Hatch, Ruth: D. Cosmos, 59:961 (Oct.) 1917.

In order to eliminate contaminating organisms in their study of the bacteriology of dental caries, these workers inserted temporary fillings in the open cavities without attempting to disturb the bacterial flora. These fillings were removed after periods varying from six weeks to three months and the cavities were then cultured. They were able to isolate in each case aciduric bacilli of the Moro-Tissier group. These organisms presented the same morphologic characteristics as the gram-positive acid-producing bacilli isolated by Moro and Tissier from the intestines of nurslings. When open cavities were cultured without preliminary precaution of the temporary filling, the various coccal forms were isolated along with the aciduric rods.

In this manner, Howe and Hatch presented further evidence that the bacilli were associated with the process of caries, while the coccal forms which are always present in the mouth were contaminants. In the list of organisms associated with dental caries, these observers named *Bacillus acidophilus, Bacillus bifidus,* and *Bacilli M, X* and *Y*. It is now recognized that *M, X* and *Y* are forms of *Bacillus acidophilus.*

After the work of Kligler and Howe, there were many investigations which pointed toward a close relationship between *Bacillus acidophilus* and dental caries. McIntosh, James and Lazarus-Barlow[12] were able consistently to isolate an aciduric bacillus from carious dentin. This organism, which they named *Bacillus acidophilus-odontolyticus,* resembled the acidophilus group of Moro, but these workers recognized a few points of difference. They were able to produce caries *in vitro* by subjecting teeth to cultures of *B. acidophilus-odontolyticus.* Decalcified sections of the dentin showed the invasion of the dentinal tubuli by these organisms as is seen in true caries.

The same year, Rodriguez[13] reported findings which substantiated the conclusions of Kligler, Howe and McIntosh; namely, that members of the lactobacillus group were always present in active dental caries. Rodriguez also produced caries experimentally by immersing previously sterilized teeth in cultures of *Bacillus acidophilus.*

Bunting and Palmerlee[14] found *B. acidophilus* present 100 per cent in thirty-eight cases of beginning cervical caries. Of sixteen cultures taken from deep, advanced lesions, fifteen were positive for *B. acidophilus.* Nineteen patients who had never had any manifestation of dental caries yielded but three positive cultures for *B. acidophilus.* In succeeding publications, Bunting and his collaborators presented data obtained from thousands of cases which confirmed their preliminary findings concerning the close correlation beween the occurrence of *Bacillus acidophilus* and the incidence of dental caries. They also succeeded in producing caries *in vivo* by the application of *B. acidophilus* cultures to the surface of teeth by means of gold cups.

Clarke,[15] in 1924, and Maclean,[16] in 1927, found that although *Bacillus acidophilus* occurred more frequently in the superficial layers of dental caries, *Streptococcus mutans* could more often be found nearer the pulp. For this reason,

12. McIntosh, James; James, W. W., and Lazarus-Barlow, P.: J. Brit. D. A., 43:728 (Aug. 1) 1922.

13. Rodriguez, F. E.: Mil. D. J., 5:199, (Dec.) 1922.

14. Bunting, R. W., and Palmerlee, Faith: Rôle of Bacillus Acidophilus in Dental Caries, J.A.D.A., 12:381 (April) 1925.

15. Clarke, J. K.: Brit. J. Exper. Path., 5:141, 1924.

16. Maclean, I. H.: Brit. D. A. J., 48:579 (May 16) 1927.

these authors attributed greater significance to this organism.

Schlirf,[17] in 1926, considered all aciduric organisms found in the mouth responsible for the decalcification of dentin. Although he emphasized the acidophilus type of organism, he believed that the acid-producing streptococci which ordinarily occur in the mouth were not exempt. Schlirf associated the acidophilus type with rapid caries and the streptococci with slow, low-grade caries.

In 1927, one of us (P. J.),[18] working independently, found that *B. acidophilus* could be consistently isolated from active dental caries and that caries did not occur in mouths which were consistently free from this organism. It was also shown at this time that the presence of *B. acidophilus* in the mouth precedes the clinical manifestation of dental caries by as much as two or three months. This observation was recently confirmed by Enright and Friesell[19] and again substantiated by the Michigan group, the possibility that *B. acidophilus* was a secondary invader being thus eliminated.

In 1929, we[20] called attention to the fact that *B. acidophilus* might occur sporadically in the mouths of individuals apparently immune to the disease. One case in particular was mentioned in which the organism appeared intermittently in the mouth of an adult who had never had caries. Cultures were taken of this case several times a day for a number of weeks, and it was found that the organism was most likely to be present shortly after the patient had had his breakfast, while cultures taken after 4 o'clock in the afternoon were almost always negative. This was suggestive of some condition operating in that mouth which was inhibitory to the growth of *B. acidophilus*. We have since accumulated more information to support this view.

Thompson,[21] in 1931, was able to substantiate the findings of the Michigan group relative to the close correlation between *B. acidophilus* and dental caries. In contrast to the overwhelming evidence of Kligler, Howe, McIntosh, Rodriguez, Bunting, Hadley,[22] Schlirf, Jay, Thompson and others, Tucker,[23] in 1932, reported that he failed to isolate *B. acidophilus* from as many as 30 to 50 per cent of individuals having three or more cavities. He maintained that if this organism is the cause of dental caries, one should always be able to isolate *B. acidophilus* from carious areas, and questioned the specific relationship of this organism to the disease. We would be in complete agreement with this view were it not for the fact that we are confident that the organism is present in and can be isolated in *all* cases of *active* caries.

In a review of the literature from the time of Goadby until the present, one is impressed by the uniformity of opinion regarding the importance of *Bacillus acidophilus* in the etiology of dental caries. Conclusions concerning the rôle of any organism in this disease can be correctly drawn only after long and in-

17. Schlirf, K.: Centrbl. f. Bakt., Parasitol. u. Infekt., 99:129, 1926.

18. Jay, Philip, and Voorhees, R. S.: D. Cosmos, 69:977 (Oct.) 1927.

19. Enright, J. J., and Friesell, H. E.: J. D. Res. 12:759 (Oct.) 1932.

20. Jay, Philip, and Voorhees, R. S.: Bacteriology of Dental Caries with Special Reference to Bacillus Acidophilus, J.A.D.A., 16: 2054 (Nov.) 1929.

21. Thompson, R.: Proc. Soc. Exper. Biol. & Med., 29:103 (Oct.) 1931.

22. Hadley, Faith P.: Further Studies on Recognition of Bacillus Acidophilus, J.A.D.A. 19:28 (Jan.) 1932.

23. Tucker, W. H.: J. Infect. Dis., 51:444 (Nov.-Dec.) 1932.

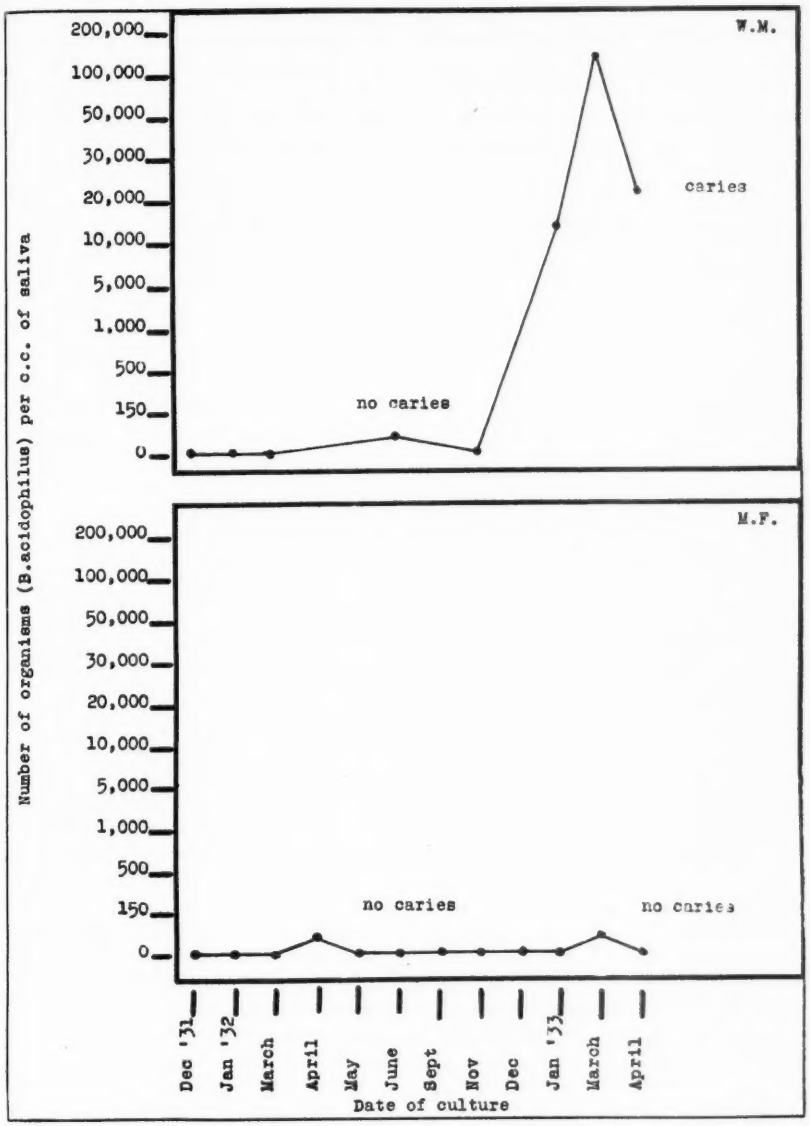

Fig. 1.—Relation of Bacillus acidophilus to dental caries.

tensive study because of the many difficulties which enter into the problem.

It is easy enough to recognize *Bacillus acidophilus* in active dental caries, but

the determination of the state of activity of the disease is no simple procedure. We have found that the most experienced and critical dentists find it extremely difficult in many cases to ascertain whether the process of tooth decay is active or latent, even when the patient has been seen many times during a two-year period of observation. The presence of one or more open cavities is not conclusive evidence that conditions favoring the progress of dental caries are present at the time of examination. Such a picture may remain

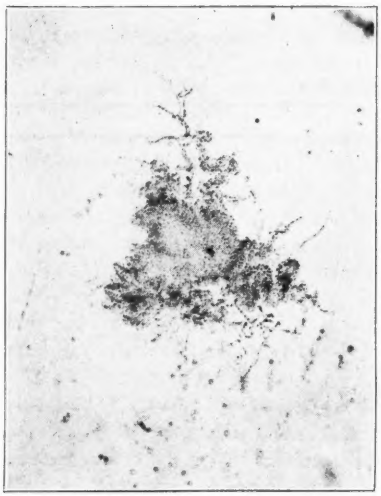

Fig. 2.—Typical B. acidophilus R colony isolated from mouth of rat. (×60.)

unchanged for several years. A positive diagnosis of active caries can be made only when new cavities have appeared or old ones have been definitely extended in the interval between successive examinations.

It must also be borne in mind that the occasional presence of *B. acidophilus* in the mouth of a caries-free individual does not minimize its importance in the disease process, unless it can be shown that the organism has thrived in that mouth for a considerable length of time without the formation of new cavities. To state it otherwise: *B. acidophilus* may and frequently does occur sporadically and in small numbers in the saliva and sometimes on the teeth of individuals apparently immune to dental caries. This is very well illustrated by the two charts in Figure 1, in which are depicted the results of quantitative determinations of the presence of *B. acidophilus* in the saliva of two children. At the onset of this study in December, 1931, neither of these children was having active dental caries, as was determined by the fact that no lesions had occurred by June, 1932. On the examination of the upper chart (W.M.), it will be seen that cultures taken prior to June, 1932, were negative for *B. acidophilus*. In June, while there was as yet no clinical evidence of caries, the culture was positive and the organisms were present in small numbers. In November, the cultures were again negative; but from that time until April, the organisms were found in the saliva in great numbers, ranging from 10,000 to 150,000 per c.c., and the clinical examination in April revealed new caries. It is reasonable to assume, therefore, that the carious process was active between November and April. During that time, the mouth was heavily infected with *B. acidophilus.*

In the lower chart (M.F.), the picture is quite different. Here again, the patient had no caries at the beginning of the experiment. In April, 1932, the cultures were positive although the count was low. In May, the cultures were again negative, and in June it was found that no caries had occurred. Succeeding cultures continued negative until March, 1933, when another positive culture was obtained. The culture taken the following month was negative, and the clinical ex-

amination in April revealed no new caries. We may assume that the organism was only sporadically present during the period of observation and that conditions in that mouth were not favorable for its cultivation and caries did not occur. It can readily be seen that if an investigator had happened to examine this child only twice, April, 1932, and March, 1933, at times when the cultures were positive, he might have been led to believe that the organism regularly inhabited the mouth and that caries did not necessarily follow. It is very obvious that such was not the case in this instance.

W.M. and M.F. were two out of thirty-six children whom we were able to examine both bacteriologically and clinically at regular intervals over a period of eighteen months. Twenty-three of the entire group remained free from dental caries throughout this study and *B. acidophilus* was found to be either entirely absent or only sporadically present, as in the case referred to in Figure 1. The remaining thirteen cases developed new caries during the period of observation and, in each case history, it could be seen that these mouths were heavily infected with *B. acidophilus* prior to the appearance of the lesion. These findings afford further confirmation of the belief, expressed by us in 1929 and more recently by Enright and Friesell, that the occurrence of dental caries is preceded by the appearance of *B. acidophilus* in the mouth.

It has been difficult for some observers to appreciate that, although *B. acidophilus* is almost universally present in the mouths and intestinal tracts of the majority of the population, there remains a minority in whose mouths this organism not only does not reside but also is apparently unable to exist. It is among this fortunate minority that we find those peculiar individuals whose teeth do not decay. We have examined the feces of

TABLE 1.—RESULTS OF B. ACIDOPHILUS FEEDING IN HUMAN BEINGS

Patient	Feces Cultures B. Acidophilus 4/7	4/8	4/9	B. Acidophilus Milk Daily 4/10–4/14 inclusive	Strains Recovered from Feces 4/14	4/15	4/16	Agglutination	4/25	5/2
D. P.	.....			Strain 134R.....	+ 134R	+ 134R	+ 134R	(1-1280)	.....	.....
J. G.*	.....			Strain 134R + lactose.....	0	0	0	.....	0	.....
D. J.	.....			Strain 134S.....	+ 134S	+ 134S	+ 134S	(1-5120)	.....	.....
J. S.	.....			Strain 134S.....	+ 134S	+ 134S	+ 134S	(1-5120)	.....	.....
E. M.	.....			Strain 134S + lactose.....	+ 134S	+ 134S	+ 134S	(1-5120)	+ 134S	0

134R Homologous titer 1-5120
134S Homologous titer 1-10,240
0 No culture
*Diarrhea followed ingestion of B. acidophilus milk and lactose.

many of the subjects under our observation and have been able to isolate cultures of *B. acidophilus* from most of them. We have found that in those cases in which the feces were negative for *B. acidophilus* there was no dental caries. These observations suggest that conditions prevail in these persons which are inhibitory to the growth of this organism. In a previous study, Bunting, Crowley, Hard and Keller[24] fed caries-free patients *B. acidophilus* milk and reported that they did not succeed in implanting the organism in mouths in which it had not previously existed. This experiment was recently repeated in order to determine whether *B. acidophilus* can be successfully implanted in the intestinal tracts of persons whose mouths are free from *B. acidophilus*.

Fig. 3.—Cells from R colony shown in Figure 2. (×1,000.)

We selected for this study five children whose mouths had been free of *B. acidophilus* and dental caries for several years. Two of them had given a history of complete freedom from caries. We had already found by repeated cultures over a long period of time that *B. acidophilus* did not exist in their mouths. The feces were also examined and found to be free of the organism. They were then fed acidophilus milk which had been prepared with strains isolated from dental caries. Immune serums for these strains were prepared in order that they might be readily identified by the agglutination test, in the event of the subsequent recovery of *B. acidophilus* organisms from the saliva or the feces after the ingestion of the milk. Cultures were made of the saliva and the feces at intervals subsequent to the final feeding.

The procedure and results of this experiment are outlined in Table 1. The feces cultures in all cases were negative for *B. acidophilus* on three successive days (April 7-9). Two of the patients (D.P.

24. Bunting, R. W., et al.: Prevention of Dental Caries Through Limitation of Growth of Bacillus Acidophilus in Mouth, J.A.D.A., 16:224 (Feb.) 1929.

and J.G.) received 350 c.c. of milk prepared with a rough strain (134R) daily for five days. It will also be noticed in Table 1 that J.G. received lactose in addition to the milk, in order to create optimum conditions for the growth of *B. acidophilus* in the intestinal tract. The remaining children (D.J., J.S. and E. M.) received milk prepared with a smooth strain (134S). E.M. also received lactose. Except in the case of J.G., feces were obtained on three consecutive days following the ingestion of the milk and *B. acidophilus* was recovered from all of them. In each case, the strain isolated resembled both morphologically and serologically the organism given to the child and we assumed that it was the identical strain. Saliva cultures taken at this time remained negative. Feces cultures taken eleven days after ingestion of the milk were negative, except in the case of E.M., who had received lactose. One week later, all available feces specimens were negative. At this time, it will be noticed that J.G. also provided a specimen which was negative. Unfortunately, we were unable to obtain the final specimen from E.M. Saliva cultures from all of the subjects continued negative. From Table 1, it is obvious that we failed to implant *B. acidophilus* in the mouths or intestinal tracts of these caries-free persons. These observations do not indicate that dental caries can be induced by the drinking of acidophilus milk by persons who are naturally free of caries. They do indicate that conditions may exist in such individuals which definitely inhibit the growth of these organisms.

TABLE 2.—RESULTS OF B. ACIDOPHILUS FEEDING IN RATS

Diet	Rat No.	Type B. Acidophilus Received in Food June 21-25 Inclusive	Mouth Culture June 27 B. a.	Type B. Acidophilus Received in Food July 5-9 Inclusive	Mouth Culture July 12 B. Acidophilus
1	17	R 5 c.c. daily	Negative	R 5 c.c. daily	Negative
	19	S 5 c.c. daily	Negative	S 5 c.c. daily	Negative
3	21				
	29	R 5 c.c. daily each	Negative	R 5 c.c. daily	Negative
	37				
	39	S 5 c.c. daily each	Negative	S 5 c.c. daily	Negative
4	4	R 5 c.c. daily	Negative	R 5 c.c. daily	Negative
	20	S 5 c.c. daily	Negative	S 5 c.c. daily	Negative

Supplements:
Lettuce.....All rats averaged approximately 4.59 mg. three times a week.
Yeast.....All rats averaged approximately 450 mg. daily.
Cod liver oil.....All rats averaged approximately 26 mg. daily.

DIET NO. 1		DIET NO. 3		DIET NO. 4	
Unpurified casein	18	Unpurified casein	14	Unpurified casein	74
Cane sugar	56	Cane sugar	30	Cane sugar	0
White flour	0	White flour	30	White flour	0
Lard	20	Lard	20	Lard	20
Salt mixture (McC. 185)	4	Salt mixture (McC. 185)	4	Salt mixture (McC. 185)	4
Agar	2	Agar	2	Agar	2

Lilly[25] expressed the opinion that neither the presence of *B. acidophilus* nor the consumption of sugar is of importance in the etiology of dental caries. He based this assumption on the fact that he failed to produce dental caries by swabbing the mouths of rats fed on high sugar diets with *B. acidophilus* cultures. This author stated that, in this manner, he had "infected" the mouths of the rats with *B. acidophilus*. From the data published in this report, there is considerable doubt as to whether he actually succeeded in infecting the mouths of his experimental animals. There was apparently no attempt made to determine whether the organism which he introduced actually survived in the mouths of the rats.

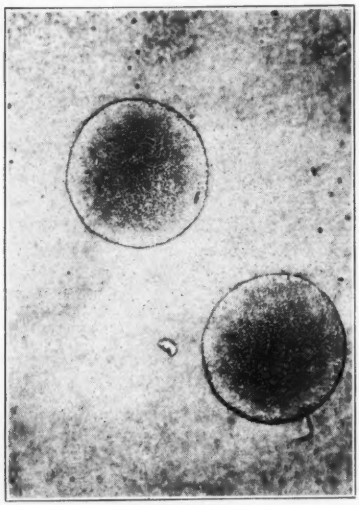

Fig. 4.—B. acidophilus colonies isolated from mouth of rat fed on Hoppert diet. (×60.)

In order to throw further light on this particular phase of the problem, we placed a group of rats on finely ground diets which were nutritionally adequate for rats, but which contained varying amounts of sugar. All of the diets were supplemented with yeast and cod liver oil. The animals were kept on these diets for nine months and then a few of each group were killed. It was found that the diets had not been conducive to the formation of dental caries. Occasional cultures from the mouths of these animals were frequently positive for *B. acidophilus* of the type commonly found in rat feces. This is not surprising as it is almost impossible to obtain mouth cultures free from fecal contaminants in the rat. With the knowledge that conditions in the mouths of these rats had not been suitable for the production of caries, we wished to ascertain whether *B. acidophilus* isolated from dental caries could grow under these conditions. Consequently, the remaining rats were inoculated with *B. acidophilus* by adding heavy suspensions of forty-eight hour broth cultures to their daily rations. Cultures were also mixed with the cod liver oil, which the animals relished and consumed immediately. Stabilized rough and smooth strains of *B. acidophilus* were used. Homologous serums for each of the strains were available for identification purposes in the event of ultimate recovery of the organisms from the rats.

It will be seen in Table 2 that in no instance were we able to isolate these organisms from the mouths of the caries-immune rats, despite the fact that they had consumed *B. acidophilus* culture in enormous doses. It is apparent from this experiment that the rat cannot be infected with *B. acidophilus* by merely exposing him to the organism. This is an indication that the factors in immunity against dental caries in the rat also inhibit the growth of human strains of *B. acidophilus*. The fact that Lilly did not produce caries in rats by the method which

25. Lilly, C. A.: J. Nutrition, 5:175 (March) 1932.

he employed cannot therefore be considered as tangible proof that *B. acidophilus* is not related to it.

The fact that Hoppert,[26] Weber and Canniff have produced dental caries in rats by feeding various forms of coarsely ground diets over a period of eight weeks and have found that the same diet finely ground produced no caries is very significant. The Michigan group, Rosebury[27] and others have confirmed these observations.

In a bacteriologic study of rats carried on the Hoppert diets, it was found that a type of organism was present in the mouth which was distinctly different from that commonly found in rats. The typical organism of the rat is a thick rod having colonies that are more or less rough. (Figs. 2-3.) We have rarely recovered the characteristic slender palisaded rods usually associated with dental caries from a caries-free rat. In rats on the Hoppert diet, the flora was predominantly aciduric and *B. acidophilus* occurred in colonies more closely resembling the smooth types. (Figs. 4-5.) The flora of the rat can be changed at will by changing the diet, as is illustrated in Table 3. All of the cultures made from rats on the Hoppert diet were positive for *B. acid-*

TABLE 3.—EFFECT OF CARBOHYDRATE FREE DIET ON B. ACIDOPHILUS IN RATS

Rat No.	Hoppert Diet Dec. 8–Dec. 21, 1932					Carbohydrate Free Diet No. 4 Dec. 21, 1932–March 6, 1933		
	Mouth Cultures for B. acidophilus December					Mouth Cultures for B. acidophilus January		
	12	14	15	16	18	14	16	18
60	S* — R	R† — S	S	S — R	S	..	S — R	R
61	R — S	R — S	S	S — R	R — S	..	..	..
62	R=S	S	S	S=R	R — S	..	..	R
63	R=S	S	S	R — S	R — S	R	R	S
64	O	S	S	S	S	..	R	R
65	R=S	S — R	S	S	S	..	..	..

*Smooth predominating type †Rough predominating type

26. Hoppert, C. A.; Webber, P. A., and Canniff, T. L.: J. D. Res., 12:161 (Feb.) 1932.

27. Rosebury, Theodor: Arch. Pathol., 15:260 (Feb.) 1933.

ophilus and, as seen from the table, the S colonies predominated. When the rats were taken off the Hoppert diet and placed on the sugar-free diet previously outlined in Table 2, the flora changed decidedly within one month. Two of the rats had become negative for *B. acidophilus,* and S colonies were seen only twice in the remaining rats. It is interesting to note that the flora of the rats on the Hoppert diet is the same whether the diet is of the fine or of the coarse variety, although use of the coarse diet is much more conducive to the formation of caries. Hoppert, in a personal communication, stated that, as a result of certain *in vitro* experiments, it was his belief that coarse particles allow circulation of saliva; whereas, the finely ground meal becomes closely packed and therefore more impervious to the saliva. It is his belief that acid is not so readily formed under the impaction of the fine material because of lack of moisture. Be that as it may, there is no question that conditions in the mouth of the rat are not altogether comparable to those of the human mouth and that the drawing of definite conclusions in this particular problem from rat experimentation is open to serious question.

The impression has long existed, especially among the laity, that the consumption of excess sweets predisposes human beings to dental caries. Although we have as yet no conclusive proof that this is always true, there is nevertheless considerable evidence which points in that direction. If the consumption of sugar is conducive to the production of dental caries, its withdrawal or addition to the diet should primarily affect the welfare of *B. acidophilus.* This we have found to be true in a study of five cases under close dietary supervision in which both sugar and starch were restricted. The patients selected were of the highly susceptible type and they were willing to forego the pleasure and convenience of unrestricted

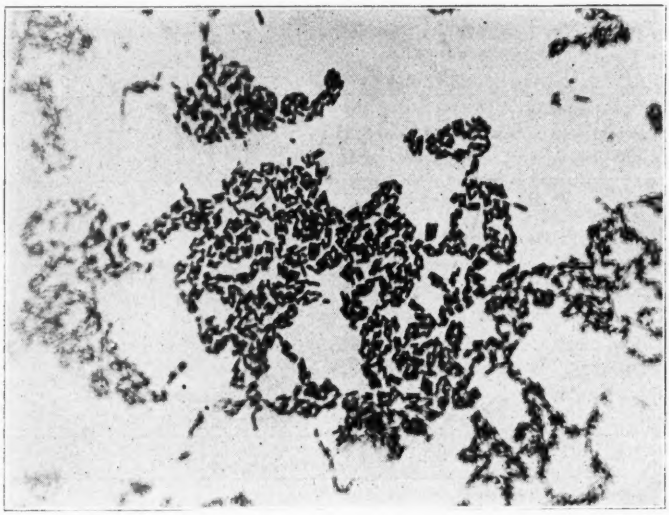

Fig. 5.—Cells from colony shown in Figure 4. (×1,000.)

diets in the hope of improving their dental conditions. A history representative of this group is charted in Figure 6. This was a particularly good case as the patient was unusually conscientious about following instructions. It can be noticed from the chart that the count during a preliminary two month observation period ranged from 75,000 to 290,000 organisms per cubic centimeter of saliva. Within one month after a diet low in both starch and sugar was adopted, the count dropped to 900 organisms per cubic centimeter. A return to her customary high carbohydrate diet was followed by an immediate rise in the count to over a million. Later, when sweets were omitted, but small amounts of starchy food consumed each day, the bacterial counts decreased to 130,000. In February, even this small amount of starch was again withdrawn and the count dropped down to 100 organisms per cubic centimeter. The remainder of the chart shows the return of the count to the original normal level for this patient when a moderate carbohydrate diet was resumed. This interesting case record will receive further

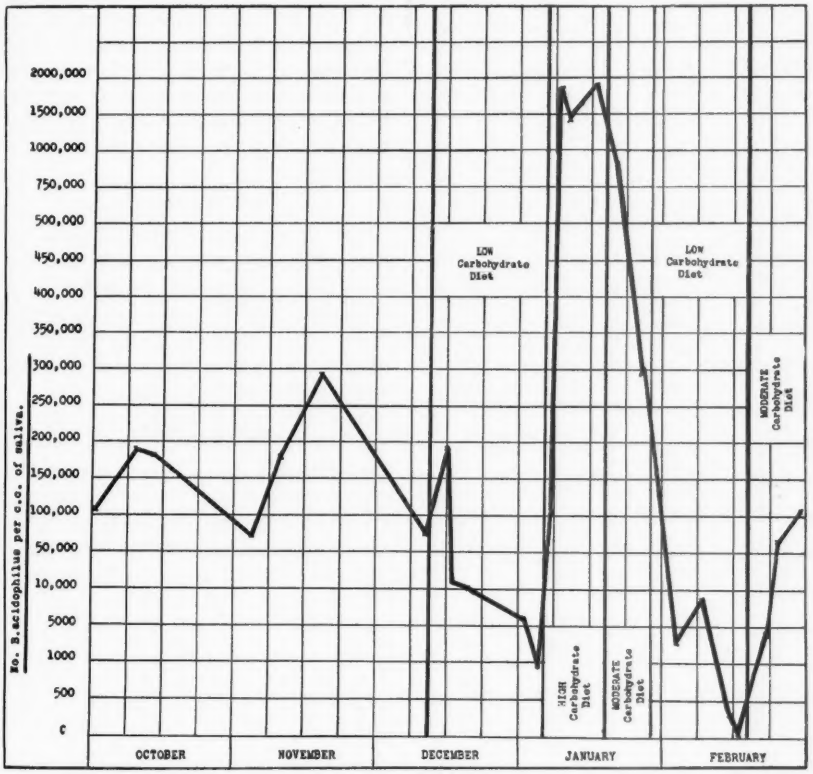

Fig. 6.—Variations in number of B. acidophilus in saliva produced by changes in diet.

consideration in other publications from this group. The bacteriologic findings are comparable to the variations that took place in the flora of the rat when change was made from the Hoppert to the carbohydrate free "noncaries-producing" diet.

TABLE 4.—B. ACIDOPHILUS AGGLUTININS IN CARIES-SUSCEPTIBLE AND CARIES-FREE PERSONS

Caries-Free		Caries-Susceptible	
Patient	Titer	Patient	Titer
E. B.	320	J. K.	.....
C. H.	80	G. R.	.....
M. S.	160	L. T.	.....
J. E.	40	F. B.	.....
R. R.	320	R. R.	80
O. L.	320	P. S.	.....
B. D.	640	N. I.	.....
E. E.	160	R. L.	.....
J. F.	320	I. H.	40
M. R.	640	E. W.	20
P B.	40	J. H.	80
R. A.	160	W. W.	80
J.	40	G. M.	80
C.	160	M. W.	20
S.	80	B.	.....
E.	320	C.	.....
G. D.	80	H. B.	.....
L. J.	320	H. E.	.....
R. L.	640	T. T.	.....
H. L.	320	W. B.	.....
F. C.	20	D. I.	.....
D. J.	80	D. W.	.....
D. P.	80	H. W.	.....
R. B.	320	M. B.	.....
M. S.	80	B. C.	40
R. O.	160	G. H.	40
W. C.	160	E. J.	20
F. S.	160	B. K.	160
L. S.	160	V. M.	.....
J. G.	320	T. M.	.....
.....	.....	C. M.	.....
Average	211.3	Average	21.2

It must be mentioned at this point that not all individuals react similarly to dietary changes. In our experience, in those individuals who are normally immune to caries, excess carbohydrate intake does not produce *B. acidophilus* overgrowths. There may occur in these individuals a temporary flare up in which the organisms reach a count as high as 100 or 200 per cubic centimeter of saliva at the onset, but after a day or two, they again disappear. This phenomenon, along with our observation that we could not successfully implant *B. acidophilus* in the mouths of so-called immune persons, suggested the possibility that there may exist an immunologic principle directed specifically against *B. acidophilus* which protected these persons against dental caries.

IMMUNOLOGY

One cannot enter into a discussion of the immunology of dental caries without certain misgivings. As we stated in a preliminary report,[28] dental caries differs from other infectious diseases in many respects. It is true that it behaves like many exanthematous diseases in that it is more common in children than in adults and, like many infectious diseases, an attack of dental caries does not result in permanent immunity against the disease. From an immunologic standpoint, dental caries is unique. In the first place, true immunity to dental caries, if there is such a thing, is extremely rare. Secondly, we know that the damage to the tooth is not accomplished by means of a toxin although we have seen that certain cyclostages of *B. acidophilus* cannot be injected into man or animals with perfect impunity. From our present knowledge of immunology, it would be extremely difficult to explain how circulating antibodies could restrain the activity of *B. acidophilus* on the surface of a tissue as

28. Jay, Philip; Crowley, Mary, and Bunting, R. W.: Preliminary Studies on Immunology of Dental Caries, J.A.D.A., 19:265 (Feb.) 1932.

inert as dental enamel. Nevertheless, we have observed reactions in the human body which are not unlike the responses provoked by invading organisms.

We reported, in a previous publication,[28] that individuals susceptible to dental caries respond positively to intradermal injections of *Bacillus acidophilus* filtrate. This reaction does not have a 100 per cent correlation with susceptibility to dental caries, but the results of a recent compilation indicate that some relationship does exist. The test is performed by the intradermal injection of 0.1 c.c. of purified *B. acidophilus* filtrate. A positive test is indicated by a localized area of erythema at the point of inoculation which usually appears between eight and ten hours after the injection. The reaction subsides and eventually disappears within sixteen hours.

The filtrate was prepared from forty strains of *B. acidophilus* isolated from dental caries. Five day broth cultures were pooled and passed through a Berkfeld N candle. Ice-cold 95 per cent alcohol (containing 0.3 per cent acetic acid) was slowly added to the filtrate in a graduated cylinder. This was shaken thoroughly and the mixture placed in the refrigerator over night. The resultant precipitate was recovered by centrifugation and taken up in sterile 0.85 per cent salt solution. The precipitate was concentrated at this point. We have found a 50 per cent concentration satisfactory in most instances. The solution was once more filtered to insure sterility, and 0.5 per cent phenol added as a preservative. The material was placed in vials and stored in the refrigerator until ready to be used.

TABLE 5.—EFFECT OF B. ACIDOPHILUS VACCINE ON RATS

Number of Rats	Type of Diet	Vaccine	Agglutination	Caries	Abscess Formation
5	*	Autogenous smooth	.....	5+	5−
10	Coarse	Rat B. a. mixed	.....	8+, 1?, 1−	4+, 6−
10	Coarse	Human smooth B. a.	.....	10+	10−
10	Coarse	Human rough B. a.	.....	9+, 1−	10+
6	+	Human rough B. a.	.....	6+	6+

*Started on fine diet, changing to coarse after six weeks; vaccination begun nineteen days before change to coarse diet.

†Fine diet, four and one-half weeks; coarse diet, eleven and one-half weeks; vaccination begun with change to coarse diet.

We have encountered a few individuals who were sensitized to phenol. Phenol reactions appear earlier and are more intense than the bacterial filtrate reaction. The suspicion of a phenol reaction can be confirmed by placing a pledget of cotton saturated with 1 per cent phenol on the skin for a few minutes. If the patient is sensitized, a similar reaction will occur.

Eighty-three caries-susceptible patients were skin tested with the purified *B. acidophilus* filtrate. Seventy-five or 90 per cent of them, reacted positively,

while eight, or 9 per cent of the group, gave negative reactions. Of the forty caries-free persons tested, twenty-eight, or 70 per cent, gave negative reactions, and twelve, or 30 per cent, positive. There was a definite tendency for the negative reaction to occur in the caries-free group; while the large majority of the caries-susceptible persons gave positive reactions to the test. It is obviously desirable to augment the caries-free group for further study, but material for such a study is difficult to obtain. We have tried to select in this group persons

Fig. 7.—Abscess in rabbit following subcutaneous inoculation of R B. acidophilus vaccine.

who had never had caries and might be considered permanently immune. We learned that no such permanent classification could be made. Two of our best "immunes" developed cavities for the first time at 20 and 22 years of age, respectively, while under our observation.

We mentioned in our preliminary report that we were unable to desensitize susceptible persons with subcutaneous inoculations of the filtrate, but that when a polyvalent vaccine was used, we were more successful. We also observed at that time that the change in the reaction to the filtrate which took place after the vaccination was accompanied by the appearance of *B. acidophilus* agglutinins in the blood stream. In view of the suggestive specificity of the skin reaction to caries activity, these findings indicated the possibility that individuals naturally free of caries might also have *B. acidophilus* agglutinins. From the results listed in Table 4, we see that this is, in a great measure, true. The average *B. acidophilus* agglutinin titer for thirty caries-free patients was found to be 1-211 as compared to 1-20 for thirty-one patients with active caries. The practical application of this information would be to attempt to vaccinate susceptible patients in order to raise the agglutinin titer to the level of caries-free persons. We had an indication that this was possible, as we had already apparently raised the *B. acidophilus* agglutinin titer in the two children who were successfully desensitized with the polyvalent vaccine. The only obstacle to such a procedure was the fact that these two children developed severe abscesses after administration of the vaccine. It therefore became highly desirable to eliminate its irritating properties before administering it to other children.

The Hoppert method of producing caries was again utilized for further studies and a series of animal experiments was begun. Since the polyvalent vaccine which had caused the abscesses in children contained both rough and smooth cultures, each of these types was tested separately. A series of rats was divided into groups of three, for the purpose of testing R, S and mixed vaccines. Subcutaneous injections were made totaling 4.5 c.c. over a period of ten weeks; at the end of which time, the rats were killed

and examined for caries. Those that had received the rough vaccine had no caries; whereas, the remaining six had an unusual amount of caries. It seemed at first glance that the rough vaccine had successfully protected the rats against caries. Strangely enough, the serums of all of the animals were entirely devoid of agglutinins. This was certainly an indication that the vaccine had not been antigenic for rats and that the failure of some of the animals to develop dental caries was due to some circumstance other than the use of the vaccine. The experiment was not without value since we found that the animals that received the smooth vaccine had no abscesses. The rats receiving the mixed cultures had moderate abscess formation, while severe abscesses developed in the rats that received the rough vaccine. Apparently, *B. acidophilus* in the rough phase contained the irritant that provoked the abscess formation in the children.

The experiment was repeated with various vaccines on a larger number of rats. It can be seen from Table 5 that neither vaccine was antigenic for the rat, since no agglutinins had been produced and the vaccines had obviously provided no protection against dental caries. Again it was apparent that the abscess formation followed the injection of dead R cultures of *B. acidophilus*. To further confirm this observation, rabbits were given subcutaneous injections of killed R cultures of *B. acidophilus*. Abscesses appeared within forty-eight hours. (Fig. 7.) In each case the abscesses were sterile. It was found that agglutinins appeared in the blood stream of the rabbits after the subcutaneous introduction of *B. acidophilus,* which was not true in the case of the rat.

It was useless to proceed further with the vaccination of rats because of the lack of antigenicity of *B. acidophilus* in this animal. We therefore selected a group of highly susceptible children for further vaccine studies. We had hoped to minimize the danger of abscess formation by the use of autogenous vaccines. Ten children with high acidophilus counts were available for this study. Preliminary mouth cultures were made from each child and strains were selected for autogenous vaccines. Each subject was examined for agglutinins before and after vaccination. The majority of the vaccines were smooth, only three containing R strains. The vaccine was administered in 0.5 c.c. doses (200,000,000 organisms per cubic centimeter), one week apart. After the fourth dose, two children who had received R vaccines had severe subcutaneous abscesses; therefore, all of them were bled at this time and examined for agglutinins. The titers of the children with the abscesses increased from 0 to 1-640 and from 1-30 to 640, respectively; whereas, the children who did not have sore arms showed no appreciable change in agglutinin titer. *B. acidophilus* counts showed no significant change in any of the children ten days after the last injection. We realize that the time interval was too short to expect a change in the bacteriologic picture. We also know from past experience that additional sustaining doses of the vaccine would be required to maintain the elevated titer of agglutinins in the blood serum. These we had intended to give, but in view of the discomfort undergone by the children, we felt obliged to discontinue the vaccination.

It is obvious that before we can determine the practicability of this form of immunization, we must remove the irritating qualities from the R form of *B. acidophilus,* and it is toward this end that we will direct our future studies.

CONCLUSIONS

1. *Bacillus acidophilus* has been found by us and by other investigators to be constanly present in large numbers in active dental caries.

2. We have shown that when this organism is present in caries-free mouths, it is usually transient. Should *B. acidophilus* appear in a mouth previously free of dental caries and remain there in large numbers for a sufficient length of time, dental caries invariably follows.

3. We were unable to implant known strains of *B. acidophilus* in the mouths of human beings or of rats while they were immune to dental caries.

4. *Bacillus acidophilus* agglutinins can generally be demonstrated in the blood serums of caries-free persons.

5. The *Bacillus acidophilus* agglutinin titer of the blood serums of caries-susceptible patients was raised to the titer of caries-free persons by the administration of a vaccine containing the R phase of *B. acidophilus*. Such a procedure was generally accompanied by abscess formation at the site of inoculation.

6. *Bacillus acidophilus* is not antigenic in the rat.

7. The number of *B. acidophilus* organisms in the saliva of caries-susceptible patients can, in some cases, be substantially reduced by the rigid restriction of carbohydrate in the diet.

8. The failure of certain investigators to produce dental caries by swabbing the mouths of rats with *B. acidophilus* culture when the animals were living under conditions inimical to the development of dental caries is no indication that *B. acidophilus* is not the most potent factor in the etiology of dental caries. Likewise, our inability to successfully implant *B. acidophilus* in the mouth during immunity is an indication that such an immunity is at least in part directed against the welfare of these organisms.

We have tried to limit this discussion to the bacteriologic phase of our dental caries studies. We do not wish to minimize the importance of nutritional and biochemical contributions to this subject, as may be gathered from other publications by the Michigan group. We are of the opinion that metabolic processes can affect the progress of dental caries only by influencing the bacterial flora of the mouth.

STRESS DISTRIBUTION AS THE PRIME REQUISITE TO THE SUCCESS OF A PARTIAL DENTURE

By CLYDE H. SCHUYLER, D.D.S., New York City

THE practice of dentistry has made rapid progress in the past two decades, and while partial denture procedures have received liberal discussion it would seem that this form of service has not kept stride with many other branches of dental practice. It is quite possible that the partial denture with clasps has been less serviceable than most other forms of restorative work. This should not cause us to condemn this form of appliance, but rather to look for its defects. We should profit as much by our failures as by our successes. The partial

denture permits greater variations than either the fixed bridge or the appliance with precision attachments. Therefore, its success depends to a greater degree on (1) the mechanical ability and (2) the mechanical judgment of the operator, either one of which he may or may not possess. The first may be detailed to a laboratory technician, but, owing to the various problems involved, consistently good results can be secured only when the dentist possesses the latter. A knowledge of the supporting tissues of the individual's mouth is essential, and the ideal solution of the mechanical problems to be seen by the man confined to the laboratory might wreak havoc to the supporting structures of the mouth.

While this work requires the creative mind of an artist, it is an engineering science, and must be practiced with due knowledge and careful consideration of the biology of the supporting tissues. We should expect the partial denture to restore not only esthetic values and serve efficiently in the function of mastication for a reasonable period of time, but also comfort and with the least possible injury to the supporting structures.

The filling of spaces where teeth have been lost with artificial substitutes that belie their identity has too often been the primary thought of the dentist. While this is an important consideration, in these days of preventive measures, we cannot disregard the possibility of introducing periodontal disease coincidentally with the insertion of a prosthetic appliance. To restore proper maxillomandibular relations and to secure an efficient masticatory mechanism, and to retain these conditions with the least trauma to the associated tissues, must be our primary considerations, and only then can we expect the esthetic result to be of permanent value. Not only are we interested in the permanency of the restored teeth, but we recognize that the restoration should, by a distribution of stress, protect the remaining natural teeth, thereby increasing the duration of their usefulness.

Roentgenograms of the entire mouth should be taken routinely before the initiation of any reconstructive work. This not only enables us to exclude infected or questionable teeth, but it is a safeguard against the presence of hidden roots or other sources of infection, and may be of inestimable value in determining the worth of the remaining teeth as abutment supports and the density of the bony structure in areas of ridge support.

Restorations supplying more than one or two teeth should be planned only after good casts have been made and mounted upon an adjustable occluding instrument. Disharmony of occlusion, leverage and tooth inclination or other complications can be determined with greater accuracy in this manner, and the final benefit is sufficient to warrant the time expenditure. These casts serve also as a means of conveying our problems to the patient, thus assuring greater cooperation and obviating a possible misunderstanding of necessary procedure or the nature of the restoration.

We are too prone to accept the remaining natural teeth as we find them without giving thought to the fact that their form may be modified by grinding or building up the occlusal and incisal surfaces, producing harmony in function and, where possible, greater harmony with the features of the patient's face. Prominent tooth ridges or tooth cusps may be reduced to give space between opposing teeth for occlusal rests. It may also be desirable to eliminate deep pits or fissures where rests are to be placed, as rests placed over a smooth highly polished surface are

less inclined to cause caries. Teeth often present difficulties in clasping owing to extreme bell contours or unfavorable inclination. This contour may be relieved by grinding on the surface. An example of this inference is found on the lingual surface of the lower bicuspids and molars, and often on the buccal surface of upper bicuspids and molars or at the contact point of cuspids. The elimination of the proximal convexity of anterior teeth where the space has been lessened by tooth migration may aid in assuring esthetic values. In such grinding, exposure of dentin must be avoided and the surfaces must be highly polished. Such preparation should be completed before the final impressions are taken. Patients seldom object to such preparatory work when the necessity for it is explained to them before appliances are constructed. They are more easily assured of the harmlessness of such modification of tooth form, and if it is done at the time the denture is inserted, they may consider it a means of correcting a misfit.

Partial dentures may be referred to as tooth supported, or tissue supported, if they are supported, respectively, entirely by remaining teeth or entirely by saddle areas. Only appliances having combined support will be considered in this paper, since only this type of appliance is in accord with my conception of a desirable restoration. Furthermore, when supporting tissues are mentioned, reference is made not only to the soft tissues covering ridges, but also to the underlying bony structures and the support of the remaining natural teeth.

A poorly designed appliance may temporarily restore esthetic values and function, but eventually, through excess leverage, or lack of proper distribution of forces, permit, or be a contributing factor to, the loss not only of the alveolar structure supporting the saddles, and the abutment teeth, but also of other teeth in the same arch, or teeth in the opposing arch.

Periodontists have taught us the value of proper distribution of occlusal stress as related to the health and maintenance of the natural teeth. A disharmony of occlusion, when an abnormal burden is carried by a limited number of teeth, endangers the structures supporting the teeth given excessive function. Likewise, the full denture prosthetists have proved beyond discussion the value of balanced occlusion in minimizing the absorption of the osseous structures supporting such appliances. It should then be evident that our first problem lies in reestablishing a distribution of occlusal stress on both natural and restored teeth, and in so designing and constructing the appliance that this distribution of stress will be maintained.

In planning a partial denture, it is also necessary to consider the amount and the direction of applied force, and the ability of the abutment teeth to withstand that force, together with the available saddle areas.

To a certain degree, tissue health depends on stimulation, and stimulation in a limited amount is of value in tissue development. This biologic principle is as applicable to both the soft tissues and bony structures of the mouth as it is to all the other tissues of the body. It is equally true that excessive stimulation is destructive to these tissues.

Our problem as denture prosthetists is the reduction and distribution of stress in an effort to prevent overstimulation and destruction of the tissues supporting our appliances.

In all cases in which many teeth have been lost and partial dentures are supported by saddle areas and the remaining natural teeth, it is difficult to conceive of

a saddle with too little mobility or teeth clasped to retain the appliance which are permitted too little mobility, that normal stimulation essential to health. Unnecessary saddle mobility endangers the supporting tissues. Most of the remaining teeth have too much freedom of motion, and if subjected to unlimited or unnecessary additional stresses last but a short time. While if their mobility is limited, regeneration of supporting tissues is possible, and they become firmer and last longer. Therefore, we must, whenever possible, limit and distribute functional stresses, thereby endeavoring to keep stimulation within the bounds of tissue tolerance.

There are many possible ways of limiting stress to the tissues supporting both the saddles and the natural teeth. We have mentioned one; that is, balanced occlusion, which reduces localized trauma by a distribution of force over a greater supporting area.

Partial restorations, if given combined tooth and tissue support by distribution, reduce the force of occlusion both to the remaining teeth and to the tissues supporting the saddles. Before insertion of the appliance, occlusal stress is carried entirely by the few remaining teeth. An appliance having well-adapted saddles and occlusal rests or stops distributes the stress between the saddle area and the remaining teeth, thus relieving the teeth to some extent; at the same time, the occlusal rests limit the stress to the saddle areas. The maintenance of this division of labor is most desirable. If the appliance is constructed without occlusal rests or stops, the remaining teeth are relieved to a greater degree when the appliance is first inserted, greater stress being taken by the saddle areas, but unless the saddle areas are exceptionally favorable (that is, there are broad ridges of dense bony structure), overstimulation and absorption are a sure sequence. As absorption progresses, the proper distribution of occlusal stress is lost, and relief is no longer given to the natural teeth.

In addition, alveolar absorption of saddle areas has too often robbed the adjoining teeth of proximal alveolar support. It has been my observation that a large percentage of partial appliances constructed with only saddle support are, at best, efficient in function, or in restoring esthetic values for only a short time, after which they fail to relieve stress on the remaining teeth, and cause unnecessary destruction of ridge tissue. On the other hand, a tooth and saddle-born appliance will give efficient service in function, and restore esthetic values for a much greater period of time. The limited saddle stimulation may be a factor in developing greater density of the supporting alveolar or bony structure.

Physiologic adaptation of saddles to the tissues and the covering of proper saddle area are also essential to the health of the supporting tissues, as stress distributed over the greater area subjects the tissues to less possibility of overstimulation and destruction. Physiologic adaptation of saddles may be secured by relining the finished denture with wax as advised by Dr. Nesbit; or they may be relined with compound. In his book on partial denture prosthesis, Dr. Kennedy gives a simple way of securing this adaptation in the impression by the use of modeling compound.

The interlocking of natural tooth cusps of undesirable occlusal inclines must be corrected before restorations are made, as similar inclines on the artificial teeth might lead to rapid tissue destruction. Artificial teeth with too deep and interlocking cusps are likewise contraindicated because of the excessive lateral or anterior-posterior stress imposed on the sup-

porting teeth and ridge tissues. Leverages are reduced by the selection of a tooth form with reduced buccolingual or mesiodistal inclines, and occlusal stress can be decreased by using a tooth form with reduced buccolingual dimension. Tooth cusps should be sharp and food exits well defined. Flat undefined occlusal areas may require unnecessary force in passing through a bolus of food.

A reduction of the number of teeth placed on an appliance is often desirable. It is seldom advisable to construct a unilateral appliance of more than two teeth. While removable work with a saddle may be favored over a fixed bridge, lateral leverage is a greater factor in destruction of abutment support than stress applied parallel to the long axis of the abutment tooth. Applied force and the value of support must be a deciding factor. When abutment and ridge support is normal and the opposing teeth have only tissue support, as in the full denture, a three tooth unilateral appliance might be safely used. Unilateral replacements without tooth support at the distal end must have support on the opposite side of the arch.

The greatest value from bilateral support is secured only when rigid palatal or lingual bars are used. This is of importance. A light flexible bar will retain an appliance in rest position, but may be of no value in the distribution of lateral stress when the forces of occlusion are applied, or in maintaining the desired relation between a saddle and ridge supporting tissue. This virtually rules out the easily adapted manufactured lingual bar; and wrought wire designs as often seen in partial upper dentures. The health and permanence of ridge tissues supporting free end saddles is possible only when the proper relation between the saddle and tissue is maintained during function. The flexible lingual bar does not give sufficient support to maintain this relation.

Forces applied in a direction not parallel to the long axis of the tooth are the greatest source of injury to its supporting tissues. In the partial denture, the forces to the abutment teeth are reduced as the number of teeth used to carry the appliance is increased. We have often been told that two clasps are sufficient for any restoration. This is true, if we are considering retention as the only function of a clasp; but why should the burden of lateral forces in function be limited to only two teeth if others are available to share this burden? As a matter of comparison: If four teeth were available for a given duty, which, if properly distributed, would not overtax them, would it appear to be good judgment to overwork two, expecting to use the remaining teeth after the first two were lost?

The continuous clasp or rest, as advised by Kennedy and Woodworth, is often found serviceable, both as a means of distributing stress and as an indirect retainer to maintain stability. By its use, lateral or anterior stresses, exerted by the large prostheses, may be sufficiently distributed among a number of teeth so that little injury will result to any one supporting tooth. If an abutment tooth has been weakened by loss of alveolar support, its mobility may be limited and its duty reduced by including the adjoining teeth in the clasping. When properly used, a clasp will often serve to give support to a weak tooth and permit regeneration of its supporting tissues.

Each type of clasp has its place in partial denture construction. The cast, round or half-round wire clasp will not serve all purposes efficiently. But none of them should be condemned. The function desired of the individual clasp must be carefully considered, and then the type of clasp selected that most efficiently

serves that purpose. The half-round wire clasp is my preference in the large majority of cases. In special cases, when greater rigidity is desired, the cast clasp is used. The cast mesiolinguodistal grip clasp on cuspids, as suggested by Dr. Roach, is most useful in many cases, because it serves as a retainer with a definite rest.

The lighter gage round wire clasps are used to the greatest advantage with deep-seated occlusal rests, which support the appliance against lateral movement or rotation. They are most easily adapted and adjusted, but are also easily distorted in handling by the patient, and unless accompanied by deep-seated rests in inlays or fillings do not sufficiently distribute lateral stresses.

Stressbreakers are seldom indicated, and never those which permit all the occlusal stress to be placed upon the saddle supporting tissue, or which permit excessive movement of the denture base. As previously stated, the most nearly permanent results are secured by a distribution of force, and such distribution is impossible with connectors of this type. Some permit rotation of the clasp during insertion, but allow no change between denture base and abutments after insertion. These may be used when tooth inclination prevents clasping otherwise. The only desirable means that I have found to break the rigid connection between denture base and abutments was suggested by Dr. Rudd. Rigidity of partial lower dentures with no stressbreaker has seemed to be the more desirable.

The fact that dentures with freely moving stressbreakers may be worn at first with little discomfort to the patient is not a criterion of their success. They permit greater inaccuracies in impressions and assemblage that might cause discomfort were rigid connectors used, but their usefulness should be judged by the duration of service, and the health of the tissues involved.

Rotating axes or fulcrum lines should be given careful consideration in an endeavor to produce stability. Normal forces, tending to displace a denture when not in function, are slight. A short arm or indirect retainer may be sufficient when only gravity or the normal forces which displace a denture are considered, but deserving more serious consideration is the axis of rotation under the force of occlusion. Here, it may be quite impossible to overcome a short power arm with a comparatively long retention arm. When possible, occlusal rests should be so placed that these leverages are eliminated or reduced to the minimum. For example, when both anterior and posterior abutments are used in a bilateral case, rests are placed to the greatest advantage when the anterior-posterior axis passes through the center, or nearer the buccal cusps of the restored teeth. When the axis is linguad from the restored teeth, a leverage is created which may cause instability of the denture. Another example might be the placing of two central incisors on a prosthesis, when clasps and rests were used on the first bicuspids. Less injury would result by using rests on the lingual side of the lateral incisors, small inlays having been inserted to give a definite seat for the rests. The lateral incisors would take the greater portion of the incisive force, but this force would be in line with the long axis of the tooth, the clasped bicuspids and the cuspids if in normal contact, taking the greater portion of the forward or anterior force.

Rests should be placed when possible on a surface at right angles to the long axis of the tooth, and not on inclined planes. If the relation between the tooth

and the rest is not maintained by a clasp, it is desirable to have the seat of the rest so shaped and inclined that it will act as a retaining appliance, thus preventing loss of relation by tooth movement. Perhaps the most common error is the placing of rests on the inclined planes of anterior teeth, which results in a wedging of the teeth whenever occlusal or incisal force is applied. The placing of small inlays with definite seats for the rests in these cases may cause slight discomfort to the patient during the operation, and incur additional work for the operator, but their use is essential in preventing the development of destructive forces.

Clasps must be tapered from the fixed base to the free end. An untapered clasp might well be compared to an untapered flag pole, an archer's bow, or any other appliance in which flexibility is a requisite. Clasps seldom break at any place except near the base. This may be due to overheating while it is being connected to the base, or because of weakening while polishing, but it is more often due to a lack of proper form. Tapering not only adds to the life of the clasp, but, owing to added flexibility, also enables it to be more favorably placed for retention and, at the same time, makes it less conspicuous.

A careful study of tooth contour will reveal, with rare exceptions, favorable areas for clasp retention. These areas are found more often on the mesial and distal surfaces than on the lingual and buccal, and necessitate the inclusion of most of the tooth's circumference. Methods long used in the surveying of teeth to determine clasp position, considering the arch as a unit rather than the individual tooth, are familiar to us all, and cannot be disregarded.

Three point contact of a clasp is desirable in some instances, this depending on the requirements of the individual clasp, but we must remember that the clasp has a purpose other than retention; that is, the stabilization of an appliance and the distribution of stress. For example, a three point contact clasp does not function to distribute lateral force when shallow rests are used. The contact of the first half or rigid portion of the clasp with the tooth surface stabilizes the appliance, preventing buccal or lingual rotation around the axis of the rests.

SUMMARY

We must have accuracy of adaptation of saddles in partial restorations. We must have coordination between carefully selected clasps or attachments; but unless, in addition to these, we secure and maintain a balanced occlusion and distribution of force, our partial restorations will not serve this ultimate purpose. In the final analysis, we must observe all of these considerations if we are to achieve our objective, which is, in short, preservation of the function and health of the oral cavity, which is of inestimable importance to the comfort, health and happiness of the individuals who seek our services.

MAJOR TRAGEDIES FOLLOWING EXTRACTION OF TEETH: A CLINICAL AND NECROPSY STUDY WITH REPORT OF TEN CASES*

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THE frequency with which disastrous complications follow certain minor operations is often not fully appreciated. This is particularly true in regard to the not infrequent, serious and even fatal results of such an apparently minor surgical procedure as tooth extraction. It has been our unfortunate experience to have watched several of these patients die who, prior to the extraction of a tooth, were in otherwise apparently normal health, although subsequent necropsy often revealed some serious latent visceral disease.

In this paper, a series of ten cases will be discussed. Each illutrates one of a group of not infrequent complications which, in most instances, ended in the death of the individual. We have arbitrarily grouped our cases into four divisions, for convenience only. No doubt, there are other equally serious complications which cannot be classed under any of these headings, in which the relationship between them and trauma and infection in the jaw has not been generally emphasized, or may have been completely overlooked. We feel that too much emphasis cannot be placed upon the importance of such possible disasters as will be subsequently discussed.

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GROUP I: ACUTE THROMBOTIC VASCULAR COMPLICATIONS

Under the caption "acute thrombotic vascular complications" will be considered those complications wherein acute thrombophlebitis followed tooth extraction. In these cases, the paths of dissemination will be illustrated, the most common being the facial branches of the angular vein or deep branches of the internal jugular, particularly the pterygoid plexus. From these branches, the spread is upward into the cavernous sinus and death results usually from meningitis, septicemia or both.

REPORT OF CASES

CASE 1 (Service of H. P. Kuhn and H. A. Breyfogle.)—O.A.W., age 55, a mathematics teacher, consulted a dentist because of swollen jaw and severe toothache, and demanded that the offending tooth be extracted. Because of the severe local reaction and a pharyngitis which had been present for several days, the dentist was hesitant, but the patient became so insistent that he finally prevailed on the dentist to extract the upper right third molar. That evening, the patient had a chill, the jaw became more swollen and painful, and the temperature rose to 103 F. A physician who was called sent the patient immediately to the hospital. On examination, a severe swelling of the jaw and face extending up to the right temporal region and involving the right ear was found. The patient's symp-

toms became progressively more severe, the right eye protruded and apparently septic thrombi were present in the branches of the angular vein, the condition being accompanied by considerable cellulitis of the face. The clinical picture was typical of cavernous sinus thrombosis. The following day, the left eye protruded and the right began to recede. Symptoms of pulmonary involvement then appeared and the patient died with profound sepsis.

At necropsy, a bilateral cavernous sinus thrombosis with extension of the septic thrombi into both jugular bulbs was found. The infection had apparently reached the cavernous sinus through the branches of the pterygoid plexus and these vessels were found to be filled with autolytic purulent exudate. There was also present a diffuse necrosing cellulitis of the pterygoid muscles as well as acute gangrenous pharyngitis and stomatitis. Multiple embolic abscesses were found in the lungs. Smears from the mouth, cavernous sinus, and lung abscesses all showed a mixed infection in which fusiform bacilli and Vincent's spirochetes were very numerous. The infection had apparently seeded the lung through the left internal jugular vein since soft purulent thrombotic masses were found hanging down in the lumen of the internal jugular vein.

CASE 2 (Service of O. Jason Dixon.)—H.G.K., a boy, aged 5, had a severe toothache nine days prior to his death. His father chewed up some cloves and put the residue in a cavity between the first and second lower deciduous molar teeth, but this provided no relief from the pain. The patient was taken to a dentist, who treated the cavity, still without relief of pain. Another dentist consulted made an incision into the alveolar process of the jaw at the base of the infected tooth. Almost immediately, the child's temperature rose to 105 F., and the swelling of the jaw became very markedly increased. Some hours later, the left eye began to bulge, and twelve hours after this, the right eye began to protrude. There appeared also an extensive cellulitis of the lower jaw. Five days after the operation and nine days after the onset of the toothache, the boy died with all the symptoms of meningitis and cavernous sinus thrombosis. At necropsy, both of the findings in Case 1 were present and, in addition, embolic abscesses were found in the liver, spleen, kidneys and heart, doubtless arising from a bacteremia. There was also present an extensive osteomyelitis of the jaw.

COMMENT

These two patients presented lesions so striking and so thoroughly illustrating the venous involvement that little can be added to the discussion after reviewing the pathogenesis of the condition. Case 1 was that of a middle aged adult, and Case 2, a boy 5 years old. Both patients showed a fatal complication which is often seen to follow even slight trauma at the critical time. One of the most frequent sites for the primary infection is a pimple or small pustule on the upper lip or on the face somewhere in the course of the angular vein. When the infection is deep, the involvement of the cavernous sinus may take place by way of some of the deep branches of the jugular vein. In both of these instances, the course of the infection was by way of the pterygoid plexus, with simultaneous extension, in the first case, to the superficial veins of the face. A bilateral involvement of the cavernous sinus was encountered in both instances. In the first case, there was a mixed infection present and Vincent's spirilla and the fusiform baccilli were found in the cavernous sinus as well as in the pulmonary abscesses. In the second case, the offending organism was a staphylococcus, and the child obviously had a bacteremia, since bacterial emboli had caused multiple visceral abscesses in the kidneys, spleen and heart.

GROUP 2: REGIONAL ACUTE INFLAMMATORY COMPLICATIONS

Under "regional acute inflammatory complications," we will cite two patients, one with osteomyelitis of the jaw with a long protracted illness and final recovery, and another with a necrosing type of Ludwig's angina that resulted in death.

CASE 3 (Service of G. F. Webb.)—Mr. B., aged 30, consulted his dentist on account of toothache and swelling of the jaw. As severe trismus was present, the dentist was unable to pull the tooth. He took the patient immediately to the hospital and, under ether anesthesia, pried open the man's jaw and removed the tooth. This operation was followed within twelve hours by a terrific swelling of the jaw, high temperature, and leukocytosis. The man was dangerously ill for many days but finally recovered, although he had considerable pain in the jaw for the next two years. He finally had an acute exacerbation of pain and swelling in the jaw, which was treated expectantly with hot packs. The process in the jaw soon localized. It was opened, and a very large sequestrum was removed which had been lying dormant for two years. The patient had an uneventful convalescence.

CASE 4 (Service of Clifford Gillis.)—C. L., a laborer, aged 20, consulted a dentist on account of aching of a lower third molar accompanied by considerable swelling of the jaw. The molar was extracted with considerable difficulty and the following morning the young man had a severe chill and a high temperature, accompanied by an extensive, excruciatingly painful swelling of the neck, and bleeding from the tooth socket. The swelling advanced, finally crossing over to the right side of the neck, and the patient developed extremely labored respiration. He was brought to the hospital with a typical Ludwig's angina and a leukocyte count of 20,000. He continued to bleed from the tooth socket. The temperature was high at all times, the pulse ranged between 100 and 130, and the swelling became most marked in the submental region. This was incised, but no pus was encountered. The patient finally died from severe toxemia. At necropsy, an extensive necrosing cellulitis at the base of the tongue, extending down into the superficial and deep tissues of the neck, was found. The mandible showed also a necrosing type of cellulitis, and when the neck organs were removed, it was scarcely necessary to do more than incise around the mental process in removing them from below because of the extensive degree of necrosis which had taken place. The whole floor of the mouth had literally rotted out.

COMMENT

In the first case, the extreme trismus present should have been sufficient reason for no surgical interference. There is present either a reflex spasm or an actual inflammatory infiltration of the masseter muscles in these cases that suggest a method of Nature for making extraction extremely difficult. The clinical course in Case 3 was very stormy and, in view of the not infrequent extension of osteomyelitis into the soft parts, with subsequent involvement of the carotid sheath and extension into the mediastinum followed by death, it appears that some form of pure luck alone saved this patient's life. Osteomyelitis can occur merely from tooth infection, but when associated with trauma, the chances of producing it are naturally greatly increased.

In Case 4, we were dealing with a very severe type of Ludwig's angina. Even as far back as 1892, Moty [1] observed the remarkable frequency of dental infection as the cause of Ludwig's angina. In 1929, Ashurst [2] again called attention to this association. In eighteen cases of Ludwig's angina observed in the Episcopal Hospital in Philadelphia, dental infection was found to be either associated with or the actual primary lesion in all but three cases and even more striking was the association of Ludwig's angina with extraction of teeth.

One of the most interesting phases of the second case in this group was the absence of pus. At necropsy, the mediastinum was found not to have been invaded, but the whole neck was diffusely infiltrated with bloody exudate and all the tissues of the neck were

1. Moty: Bull. et. mém. Soc. de. Chir. de Paris, 18:536, 1892 (quoted by Ashhurst).

2. Ashhurst, A. P. C.: Arch. Surg., 18:2047 (May) 1929.

undergoing an autolytic type of necrosis. In both osteomyelitis and cellulitis, the bacterial studies are very unsatisfactory, owing to the multitude of different organisms found in smears. Frequently, it is impossible to identify the offending organism or the important one. The spread of infection to the neck in Ludwig's angina is almost invariably by direct continuity from septic cellulitis of the floor of the mouth when no surgical interference is present. As pointed out by Moty,[1] the outer wall of the mandible is so thick when a posterior or third molar tooth is infected that perforation usually occurs on the inner wall with immediate infection of the sublingual tissues. When associated with trauma, direct extension of the acute process into the floor of the mouth may take place immediately, as in the case under discussion.

GROUP 3: BLOOD DYSCRASIAS

It has long been recognized that there is a very frequent association between certain conditions in the mouth and certain blood diseases. The sore tongue of Addison's anemia is one of the most common clinical manifestations in this condition. Stomatitis, with sometimes extensive involvement of the gums, commonly accompanies leukemia, and the severe stomatitis observed in malignant neutropenia was considered by the earlier writers on this disease to be one of the pathognomonic findings. It seems unnecessary, therefore, to mention that, in every case of stomatitis, there should be a complete history, physical examination and careful blood studies, especially, before tooth extraction is even contemplated. The following three cases illustrate three different types of blood disease wherein meddlesome dentistry seemed to be decidedly harmful.

CASE 5 (Service of E. H. Hashinger).—W. B., a man, aged 24, came to his physician because of loss of weight and a run down feeling. The only finding was a mild gingivitis. He was sent to a dentist, who removed a crown and treated his gums for Vincent's infection. He continued to lose weight and strength and, when seen two weeks later, he was quite anemic and showed 14,000 white blood cells, 38 per cent of which were myelocytes. He was given six transfusions, which brought the red count from 2,000,000 to 4,000,000 but did not influence the white cell count. The gingivitis became more troublesome and the patient summoned a dentist without the knowledge of his attending physician. The dentist removed a tooth, and this procedure was followed by a gangrenous stomatitis which eventually caused a slough of the maxilla and soft palate and extended up into the antrum, finally involving the left orbit. The patient was sent to the Mayo Clinic, where he died. At necropsy, multiple brain abscesses were found. There was also a generalized mesenteric lymphatic hyperplasia and marked leukemic infiltration of the kidneys. Studies of the blood film were made by Russell L. Haden, Hal Downey and H. M. Conner, and the final opinion was that the disease was one of monocytic, rather than myelogenous, leukemia.

CASE 6 (Service of P. T. Bohan and Virgil McCarty).—F. A., a man, aged 51, entered the hospital on account of swelling of the gums and face. Three weeks previously, he had had fourteen teeth extracted, chills and sweating occurring every day thereafter for a week. The mouth, gums, pharynx and soft palate became trendously swollen. On entry to the hospital, the patient showed a white blood count of 109,000 with 95 per cent young, large immature lymphocytes. Examination revealed a gangrenous stomatitis. The patient became steadily worse and showed increasing enlargement of the cervical lymph nodes. The spleen was greatly enlarged and a diffuse generalized adenopathy was present. Confluent purpuric subcutaneous hemorrhages developed. The upper jaw became involved in the gangrenous necrosis and part of the maxilla sloughed away. The patient died with the typical findings of an acute lymphatic leukemia. Just before death, the leukocyte count had risen to 285,000, and, during his stay in the hospital, the erythrocyte count fell from 4,000,000 to 1,000,000.

At necropsy, there was seen extensive

heteroplastic infiltration of the heart, liver, spleen, bone marrow and suprarenal glands by lymphoblastic cells. There was also a marked necrosis of the maxilla, with extension into the right antrum of Highmore. Profuse submucous and subcutaneous hemorrhages were found, and the spleen and liver particularly showed a most striking lymphoblastic infiltration. The former weighed 1,090 gm. and the latter, 3,040.

CASE 7 (Service of H. L. Dwyer).—J. J., a boy, entered Mercy Hospital on account of weakness, fever and cervical lymphadenopathy. On examination, the spleen was found to be enlarged, icterus was present and there was a high grade anemia with 5,000 white blood cells, 50 per cent of which were lymphocytes. The patient ran a septic temperature for two weeks and then became somewhat better. The glands decreased in size, and he was taken home. On readmission, three weeks later, he was complaining of severe toothache. Examination revealed a membrane over the gums and tonsils. The patient was having some nosebleed and was still quite anemic. He was given a weekly transfusion, and neoarsphenamine was given three times a week. An otitis media developed and the discharge from the middle ear contained Vincent's spirilla. The temperature continued to range between 102 and 104 for the next three weeks, gradually returning to normal. During the second illness, the patient developed a gangrenous stomatitis, and the left tonsil and part of the soft palate sloughed away. The leukocyte count ran to approximately 12,000, with 88 per cent lymphocytes, many of which were immature. During the second month of illness, the leukocyte count fell from 11,800 to 2,800, and the polymorphonuclear neutrophiles disappeared from the blood. Nevertheless, the boy improved remarkably and was able to walk about the ward. During his convalescence, he developed a toothache and his dentist extracted the tooth. Immediately after the extraction, all of the former symptoms returned, the cervical glands became enlarged, and the throat was swollen and edematous. The temperature ran between 103 and 105, and twelve days after the extraction, the patient died. The last white blood cell count showed only 2,000 leukocytes, all of which were mononuclear.

COMMENT

Some writers have even hinted that tooth extraction has in some instances produced leukemia by disturbing the bone marrow, and Hill[3] has suggested that the Vincent's spirilla or some other organisms may be responsible. We have observed a not infrequent association between leukemia and extraction of teeth, and, in some instances, it was found that the blood picture previous to extraction was actually normal. Nevertheless, it is a well-known fact that severe stomatitis frequently accompanies leukemia and, in the three cases which we have recited here, some blood dyscrasia doubtless existed prior to the extraction. Even in Case 6, a history of severe, unexplained bleeding from the nose was obtained two years previously, although, at that time, the blood film was in every way normal except for the picture of a typical posthemorrhagic anemia. In the face of such a history and an extreme soreness of the mouth, another blood examination should have been made before surgical intervention. In Case 5, there was no reasonable excuse for the extraction, particularly in the face of a diagnosis of leukemia, extreme gingivitis and high-grade anemia. Any surgical procedure here was obviously hazardous since the prognosis was altogether bad. Clinically, the extraction seemed actually to cause marked acceleration of the gangrene with extension to the antrum and orbit, and final death in a very short period from multiple brain abscesses.

In Case 7, the patient lived for two months after the diagnosis of agranulocytic angina was made, and he was apparently greatly improved, being able to leave his bed and walk about the hospital. When the tooth was extracted, there was a sudden overwhelming exacerbation of all previous symptoms. A septicemia de-

3. Hill, H. P.: California & West. Med., 25:609 (Nov.) 1926.

veloped, and the patient died twelve days after the unhappy extraction.

It appears, from a study of these three cases alone, that any patient showing a severe stomatitis should have a thorough physical examination and painstaking blood studies before any dental extraction should be considered.

GROUP 4: REKINDLING OF A LATENT REMOTE LESION

After the removal of foci of infection in such apparently unrelated conditions as arthritis, neuritis and the like, it has been a frequent observation that, at times, there is a sudden and striking exacerbation of symptoms. Considerable difference of opinion has prevailed regarding the relationship of focal infection to such lesions as endocarditis, myocarditis, gastric ulcer and kidney stone. Nevertheless, we feel that, even though the so-called focus cannot be proved to be the actual cause of the distant lesion, when surgical intervention is instituted in some of these cases the attempted cure may at times be worse than the disease. We have taken three cases at random, each one illustrating a different type of lesion and each one showing a fatal termination following the removal of teeth for a focus of infection.

CASE 8 (Service of Ellis Wilhelmy).—B. P. a mining engineer, aged 59, was first seen several weeks prior to his death. He complained of attacks of dyspnea and pain in the joints. At this time, blood, pus and albumin were found in the urine and the patient had a rather rapid pulse, a low grade secondary anemia and a slight increase in nonprotein nitrogen in the blood. Examination of the teeth revealed some pyorrhea, but roentgen-ray pictures showed no obvious areas of granuloma. Diagnosis of subacute nephritis was made and the patient was placed on a milk diet. He improved somewhat, but worried about his teeth and consulted a dentist, who advised extraction. The physician who had first examined him gave specific instuctions that the teeth be not extracted, believing it to be a dangerous procedure. The patient took the dentist's advice and had two teeth pulled. Three days later, he had four more pulled. After the second extraction, he became very weak, his jaw became swollen and pus was found oozing from the tooth socket. He developed fever and a rapid pulse, and his face became swollen. A gangrenous necrosis started in the jaw and extended up into the nose. The patient finally died with severe sepsis. At necropsy, an ulcerating gangrenous rhinitis and stomatitis was found, with thrombosis of the right internal jugular vein, and multiple embolic infarcts were encountered in the lungs. There was an early adhesive pericarditis present, and a chronic glomerulonephritis was also found. Microscopic examination of the jawbone revealed some necrosis of the mandible.

CASE 9 (Service of P. T. Bohan).—L. B. N., a carpenter, aged 42, complained of attacks of dyspnea and "a burning sensation in the heart," both of which symptoms had been present for six months. These attacks were brought on by exertion and were relieved by rest. During one attack, the left shoulder felt numb and "burned." The patient had always been well before the present illness. Examination of the chest was negative except for numerous extrasystoles. The urine, blood and blood pressure were normal. There were numerous pulpless teeth present. The tonsils, which were large and red, were removed without reaction. The pulpless teeth were extracted at two appointments. During the first extraction, the patient had a severe attack of pain in the chest with dyspnea and almost died in the dental chair. Two weeks after the second extraction, he began to have marked dyspnea, which increased in severity. He complained of a feeling of pressure in the chest and developed a pericardial friction rub. Signs of myocardial insufficiency soon developed, followed by death. At necropsy, there was revealed a thrombosis of the left coronary artery with extensive myomalacia cordis. Animal inoculations by Russell L. Haden[4] yielded the following: "Two rabbits inoculated with a culture from the tonsils showed no lesions. Three roentgen-ray positive teeth, the left lower first and second bicuspids and the first molar, were first extracted. All showed a profuse growth of streptococci. Two rabbits were injected with

4. Haden, R. L.: J. Lab. & Clin. Med., 12: 31 (Oct.) 1926.

a broth culture. One showed an arthritis with a pyelonephritis. The other showed a marked necrosis of the myocardium involving almost the entire right ventricle. A slight joint involvement was the only other lesion present. One week later, four more teeth were extracted. The left upper first bicuspid and lateral incisor were roentgen-ray positive and showed a profuse growth of streptococci on culture. The left upper was negative in the roentgenogram and showed also a profuse growth of streptococci. The left upper cuspid showed only a few colonies in the agar tube and was negative in the film. Two rabbits were inoculated with the mixed cultures. One showed at necropsy slight joint lesions and yellow plaques in the arch of the aorta. The other showed lesions in the joints and muscles, marked necrosis of the heart muscle and several vegetations on the mitral valve."

CASE 10 (Service of L. P. Engel.)—A. G., a man, aged 64, had had heart burn for one year. Fifteen days prior to his death, the patient had had seven teeth extracted, and eight days before death, eight more were removed. Three days thereafter, the patient became extremely disoriented mentally. He was dizzy and had a partial loss of memory. He was put to bed, and had frontal headaches and sinking spells. Prior to this, he had not consulted a physician. Neurologic examination revealed nothing of diagnostic importance. The pulse, temperature and respiration were normal. Suddenly, convulsions developed, with symptoms of pulmonary edema, and death ensued. At necropsy, the gums were found to be well healed. There was an extensive ulcerating atherosclerosis of the basilar artery with a fresh thrombus occluding the lumen. Microscopic sections revealed an acute inflammatory lesion in the atheroma, where the thrombus was present. No other findings of importance were encountered at necropsy, except extreme cerebral anemia.

COMMENT

In Case 8, the patient was advised against having his teeth removed in the presence of what was thought to be a subacute nephritis. When informed that another physician had recommended extraction, his first physician again advised against it and sent the patient to an exodontist, who was also hesitant about the procedure. The extractionist advised that, should the patient insist on extraction, he should have the teeth removed one at a time to make the procedure as harmless as possible. The patient took the matter into his own hands and, after the second extraction, he developed a gangrenous stomatitis. He also suffered an immediate acute exacerbation of all of his previous symptoms, death ensuing.

In Case 9, an apparent coronary complication arose when the patient was undergoing the first extraction. He had at this time a very severe pain in his chest, and he became extremely short of breath and almost died in the dental chair. Moreover, the possible relationship between the thrombosis of the coronary artery and the tooth infection was strengthened by the isolation of a streptococcus from the teeth roots with which myocardial necrosis was produced in experimental animals.

The relationship between infection and coronary thrombosis has been seriously questioned, and it must be granted that the great majority of acute thromboses occur on the basis of an old previously existing atherosclerotic lesion of the vessel wall. Nevertheless, certain observers, notably Adam Boyd[5] and Benson,[6] have called attention to the possible relationship of infection to coronary disease, particularly the terminal occluding thrombosis. Boyd has recorded three cases of coronary thrombosis in which he considered that a remote suppurative lesion had caused an acute inflammation in an atheromatous plaque in the coronary artery. Benson and his associates isolated streptococci from the thrombus in a case of coronary disease, as well as from

5. Boyd, A. N.: Am. J. Path., 4:159 (March) 1928.

6. Benson, R. L.; Smith, K. G., and Semenov, H.: Arch. Path., 12:924 (Dec.) 1931.

sclerotic coronary arteries and also from the sphenoid sinus. By inoculating rabbits with cultures of these streptococci, these workers produced acute arthritis with and without thrombosis, as well as arteriosclerosis of the aorta and other arteries. These experimental lesions were quite similar to arterial lesions found in the human being. Clawson[7] was also able to produce arteritis in both rabbits and monkeys through the injection of streptococci, and Nicholas Alter[8] obtained extensive arteriosclerotic lesions in rabbits which had been fed with a highly virulent strain of *B. coli* and a high protein diet. Incidentally, we have observed a frequent association of coronary arterial disease and dental infection. Case 9 serves as an example of several similar instances which we have seen.

In Case 10, the dental interference clinically appeared to have been a factor in the fatal thrombosis of the basilar artery in the brain. A careful history of the case showed that this man, aside from gastric distress, had been singularly free from any trouble all his life. Even if there were no relationship between the tooth extraction and the subsequent fatal thrombosis, it would have been a difficult matter to convince his survivors that the extraction of his teeth was not the cause of his death. At necropsy, the thrombus in the basilar artery was superimposed upon an ulcerating atheroma and there was an acute inflammatory arteritis at this point. The entire process may have been coincidental, but the clinical sequence of removal of obviously infected teeth in large numbers with the production of an acute arteritis in the basilar artery naturally suggests a relationship between the extraction and the possible release of organisms into the blood stream which seemed to have a specific affinity for vascular endothelium, particularly when already diseased by arteriosclerosis.

We have also observed cases of subacute bacterial endocarditis which were apparently incited by tooth extraction. Blumer[9] and Welker[10] have also called attention to this condition.

SUMMARY AND CONCLUSIONS

Complications frequently follow the extraction of teeth. In a clinical and necropsy study of ten cases, we have tried to show that the removal of teeth in the stage of acute inflammation may result in death, from thrombophlebitis of the branches of the internal or the external jugular vein, with subsequent involvement of the cavernous sinus and meninges, or both. There may also be produced a fulminating osteomyelitis of the jaw, or a direct extension of the infection into the floor of the mouth, with Ludwig's angina. In either instance, death may ensue from these complications. There is a possible relationship between stomatitis and certain blood dyscrasias. In three cases cited, dental interference seemed, clinically, to cause an acute exacerbation of a previously existing blood disease, with a striking accentuation of all the clinical symptoms, rapid decline and death.

There is an apparent rekindling of certain latent or relatively inactive visceral conditions in extraction of teeth for removal of possible foci of infection, death resulting.

7. Clawson, B. J.: Arch. Path., 6:947 (Dec.) 1928.

8. Alter, N. M.: Colorado Med., 22:199-204 (June) 1925.

9. Blumer, George: Boston M. & S. J., 194: 233-237 (Feb. 11) 1926.

10. Welker, J. E.: Personal communication to the authors.

USING THE MUSCLES TO STABILIZE THE FULL LOWER DENTURE

By E. WILFRED FISH, M.D., L.D.S., D.Sc., London, England

THE chief concern of the prosthetist is not with the material of which the denture is made, but with the shape of its surfaces. As far as the impression surface and the occlusal surface are concerned, this has been widely recognized, but, apart from muscle trimming of the edges of the impression surface, it is not so widely understood that the actual shape of the whole of the buccal, labial and lingual surfaces can wreck the stability of a denture just as completely as a bad impression or a wrong bite.

It is no exaggeration to say that the principal factor in stabilizing the full lower denture is the modeling of that part of its surface which comes in contact with the muscles of the cheeks, tongue and lips. These muscles can be made to hold the denture in place while mastication is going on, or they can be made to displace it; yet nowhere in the literature does the relationship of these muscles to full dentures appear to have been described. Their importance can be quite dramatically realized by considering Figure 1, a cross-section of one side of a stable full upper and lower denture in the first molar region. The black object is a hard elusive piece of food, such as a raw onion. Now, if the teeth simply closed on this, it would shoot out into the cheek or in onto the tongue, and, to prevent either of these contingencies, the cheek and tongue grasp the object and hold it in place. In so doing, the cheek (that is, the buccinator muscle) pushes the onion inward while the tongue pushes it outward. Moreover, the pressure of the cheek and tongue will be equal, and thus the piece of food is stabilized between the teeth and held there to be crushed.

Because the buccinator is a relatively large muscle, and the side of the tongue is also fairly big, they press not only on the onion, but also on the dentures.

If Figure 2, which shows a cross-section of unstable dentures in the first molar region, is compared with Figure 1, it will at once be evident that the buccal and lingual surfaces of the lower denture in Figure 1 present inclined planes to the buccinator and tongue which compel these muscles to push the denture down at the same time as they hold the food bolus in place between the teeth; while, in Figure 2, owing to the faulty modeling of these surfaces, the lower denture is lifted up when the tongue presses against it, and the buccinator cannot get any purchase on it to hold it down. In fact, even if one could get a thumb and finger in the mouth while eating, one could not hold a slippery parallel-sided lower denture like the one in Figure 2 in place.

It will be realized that, in speaking of the buccal and lingual surfaces, or, as we may call them for convenience "the polished surface," we refer to the whole of that part of the denture which comes in contact with the tongue and cheeks when the dentures are closed in repose. This surface, the part normally brought to a

high polish on the lathe, consists partly of vulcanite and partly of the buccal and lingual surfaces of the teeth; therefore, our discussion is not at all concerned with the muscle trimming of the edges of the denture, but with the modeling of the whole buccal and lingual surface and should include in its scope the buccolingual position of the teeth on the ridge, the height of the bite, the extension of the base on the model and the waxing up between the edge of the base and the teeth. It will be possible here only to indicate the general principle which is followed.

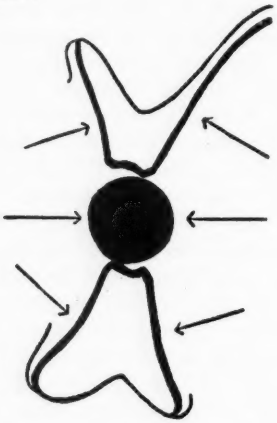

Fig. 1.—Transverse section through molar region of stable dentures biting elusive spherical object. The pressure of the tongue and cheek while holding the food in place also stabilizes the dentures by pressing on their inclined planes.

Experience tends to show that if we neglect the modeling of this polished surface, it does not matter what articulator we use, or what impression technic, for it will be a matter of luck as to whether we succeed in stabilizing the denture, and the chances are heavily against us. A moment's consideration will make this quite clear.

If there is not much ridge, the impression surface can offer no resistance to lateral displacement. The occlusal surface certainly cannot do so; therefore, our only hope lies in the third or "polished" surface. In other words, we must make the denture fit the tongue and the cheeks, both in a state of rest and also during mastication that the muscles may grasp the piece securely and hold it in place. It follows that it is necessary to study the anatomy on the tongue and cheeks, and, more than that, to learn what the muscles which form these structures do when the patient is eating,

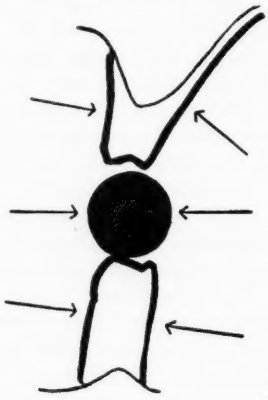

Fig. 2.—Transverse section through molar region of unstable dentures biting similar object. (Compare Fig. 1.) The pressure of the tongue and cheek in holding food unstabilizes the dentures because the planes of the buccal and lingual surfaces are presented to the cheek and tongue at the wrong angle. The lingual and buccal surfaces of the lower denture are almost parallel, therefore the muscles cannot hold it down.

in order that we may fashion flanges which will not interfere with muscular movement, but will present inclined planes on which the muscles can act to press the denture down into place all the time and prevent it from moving sideways or lifting up.

The way in which the buccinator muscle which forms the cheek helps to hold the piece of food still in Figure 1 becomes apparent when the origin and insertion of the muscle is described. It takes origin from a curved line which starts above the molar teeth in the maxilla and runs down along a ligament from the pterygoid process to the mandible, and then along the mandible just below the lower molar teeth. This arrangement is shown quite accurately enough for our present purpose in Figure 3, where the fibers of the muscle are seen proceeding from this crescent-shaped origin horizontally across the cheek to the corner of the mouth. Here, they decussate, or cross each other, and become continuous with the fibers of the orbicularis oris muscle, the circular muscle around the mouth which contracts the lips in whistling, etc. The upper fibers of the buccinator are continuous with the lower lip fibers of the orbicularis oris, and the lower fibers of the buccinator with the upper lip fibers of the orbicularis oris.

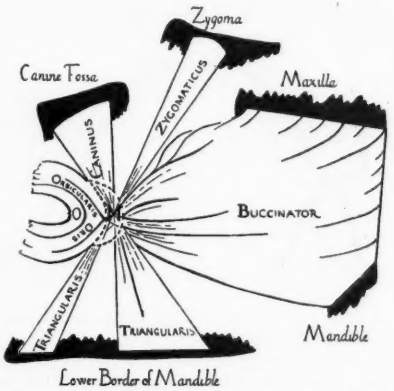

Fig. 3.—Diagram of the five muscles which are inserted in the modiolus. The buccinator and the orbicularis oris antagonize each other. M. cruciati modioli (zygomaticus, caninus and triangularis) fixes the modiolus (*M*) when either the buccinator or the orbicularis oris are about to contract.

It is clear from this arrangement that every time a buccinator contracts, the mouth ought to be pulled over to that side; but it is not, because several other muscles are also inserted in the corner of the mouth where the buccinator and the orbicularis oris meet, and serve to hold the corner of the mouth still while the buccinator is working. It is these other muscles which lift the front of a lower denture if it is too wide in the premolar region, and they are arranged in the simplest possible way. Obviously, the corner of the mouth where the buccinator and orbicularis oris meet cannot be fixed by being attached directly to bone, since there is no bone there. It is, therefore, fixed by a cross-shaped arrangement of muscles, each of which is attached to bone at its distant end, while the corner of the mouth is at the center of the cross. (Fig. 3.) In this way, the point of junction of the buccinator and orbicularis oris (Fig. 3, *M*) is, by this x-shaped arrangement of muscles, held still while either muscle is working. The individual mem-

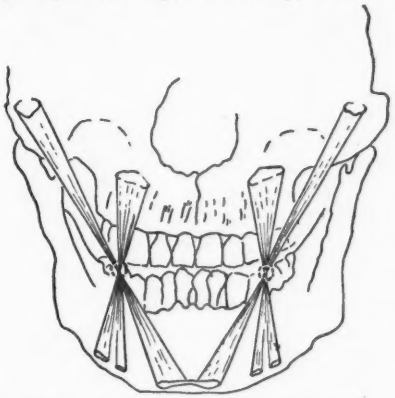

Fig. 4.—M. cruciati modioli forming v-shaped strap which tends to lift lower denture if it is too wide in premolar region.

bers of the group are the zygomaticus, from the cheek bone, the caninus, from the canine fossa, and the two parts of the triangularis, from the edge of the lower jaw and the point of the chin. The point where all these muscles meet at the corner of the mouth is called the modiolus (Latin, "hub of a wheel"), because they radiate from it like the spokes of a wheel. (Fig. 3.)

If we wish to say "oh," the modiolus is fixed in a forward position, and the orbicularis oris is free to help form the sound. Similarly, if we want to say "ee," the modiolus is fixed in a backward position, and the orbicularis is equally free to form the sound. These cross-shaped muscles, the zygomaticus, caninus and triangularis (called collectively the musculi cruciati modioli)—are equally useful when the buccinator is being used to hold food in place between the teeth. What happens is that they contract and fix the front end of the buccinator. The back end of the buccinator is already fixed to the jaws and the ligament (Fig. 3) and thus, when the muscle contracts, it humps up as the biceps in the arm does if it is contracted with the elbow and shoulder fixed. This hump is the convex pad one can feel inside the cheek which "goes hard" when the cheek is contracted. It even presses in between one's teeth if they are slightly opened.

Moreover, it is this muscle hump which can be made to press on a properly modeled flange of a lower denture, and may even be so strong that one cannot pull the denture out until the patient relaxes and lets it go.

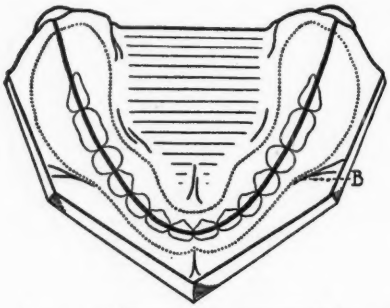

Fig. 5.—Diagrammatic representation of lower model. The black line represents the ridge, the dotted line the outline of the baseplate. The edge of the base is close to the ridge in the incisor, cuspid and premolar region buccally, and in the incisor and first molar region lingually. The edge of the base is carried away from the ridge, from the buccal frenum (*B*) backward buccally, and in the premolar and retromolar region lingually. The teeth are then set on the ridge as shown in outline (except in very flat lower denture). Simple waxing up to this line almost automatically ensures correct modeling of the polished surface.

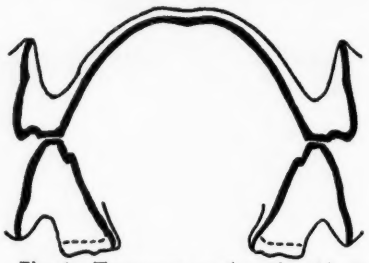

Fig. 6.—Transverse section of stable dentures in premolar region. The lower denture is very narrow at this point to escape the modioli. Its edge on the lingual side is considerably thickened to make the lingual surface look inward and upward and so avoid any risk of the bicuspid overhanging the tongue. This edge may be eased as shown by the dotted line if too deep.

To return for a moment to Figure 1: When the onion has been bitten in two, one half will push out into the cheek, and the other half in, on to the tongue. The inner half will be pushed back between the teeth and rebitten, but the outer half will slip down into a pouch under the buccinator and lie there, not interfering in the least with the action of the middle

fibers of the buccinator in holding the rest of the onion still while it is being chewed. It is this pouch under the buccinator which is to accommodate the flange on the lower denture. The presence of this pouch is not obvious when the patient opens his mouth for examination because the mucous membrane of the cheek is on the stretch, but its presence can be felt if the little finger is gently inserted between the lips into one's own cheek with the teeth closed. It can also be demonstrated by giving a small boy a hard sweet and following it up with a piece of cake. The sweet is "parked" in this pouch while the cake is eaten with the aid of the middle fibers of the buccinator. Monkeys can "park" a whole banana in these pouches, as one may observe any time at the zoo.

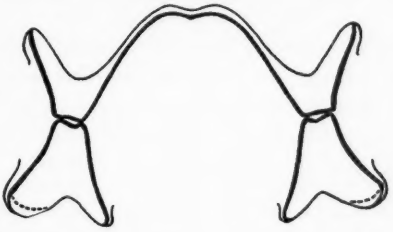

Fig. 7.—Transverse section of stable dentures in first molar region. Each side of each denture is roughly triangular in shape, the base resting on the alveolus and the apex formed by the tooth. A flange on the lower denture extends under the buccinator in order that the muscle may rest on the inclined plane so formed and hold the denture down. This flange may be eased as shown by the dotted line if necessary, but should not be made narrower unless it has been grossly exaggerated. The lingual surface looks inward and slightly upward.

It is into this pouch that the flange on which the buccinator rests is carried, and it has been found possible to fit these flanges in every one of the hundreds of lower dentures which have been made in the last few years in my private and hospital practice, which leaves no doubt of the existence of the pouch.

There is an urgent corollary to this rule. It will be recalled that the front end of the buccinator—the modiolus—is fixed by a cross-shaped muscle when the buccinator is contracting. If the cross-shaped muscles of both sides are viewed from the front, it will be seen that two of the limbs of the crosses form a v-shaped strap of muscle going from the point of the chin to the corner of the mouth and upward and backward to the prominence of the cheek bones. This v-shaped strap of muscle crosses the lower denture in the premolar region, and, if the denture is at all wide here, will lift it up every time it contracts; that is, at the moment when the buccinator is fixed to chew food; in other words, just when the patient most wants the denture to lie down. We must, therefore, when fashioning a wide buccal flange in the molar region, narrow the whole denture in abruptly as we approach the premolar region, to escape these muscles which cross at the corner of the mouth.

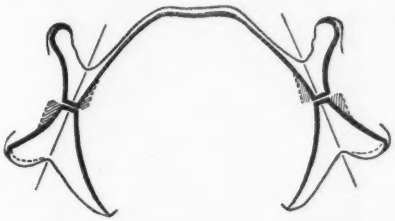

Fig. 8.—Transverse section of stable dentures in second molar region when lower arch is much wider than upper. The diagram shows that the polished surface still maintains the correct inclination to the tongue and cheeks. This is effected by using very narrow teeth (compare with the shaded area which indicates how normal teeth set on the ridge would appear) and by extending the bases of the dentures.

The result is a denture very much of the shape shown in Figure 5. In the premolar region, the whole piece is no wider than the arch (that is, the center of the teeth are over the center of the arch and there is a minimum of vulcanite on the outer side); while, in the molar region, large flanges run out to a degree which might at first be regarded as impossible. Yet this is an average case. Figure 9 shows two such lower dentures which vary in bulk, but not in general shape. The object has been to make the occlusal surface as narrow as possible, and the impression surface as wide as possible, in order that every section of the denture shall be wedge-shaped. All the lingual surfaces look inward and upward, the buccal surface looks outward and upward. The dentures are narrow in the premolar region and wide in the molar region. It must be stressed that every lower denture has the general shape of those shown in Figure 9. In a man with heavy loose lips and cheeks and a soft tongue, the whole denture will be enormous in order that the large loose cheeks may grasp it. The buccal flanges will be so great as to appear almost a caricature of a lower denture; in fact, it is fairly safe to say that, in such a case, a piece of wax the size of three-quarters inch of lead pencil may generally be added to each flange after a man who is trying this technic for the first time considers he has made it big enough. At the other extreme is the patient with tight, thin lips and cheeks and a hard tongue, with little space in the mouth. In this case, the narrowest possible teeth are used to avoid bulk, but still the buccal flange appears—thinner, of course, but exactly the same general shape.

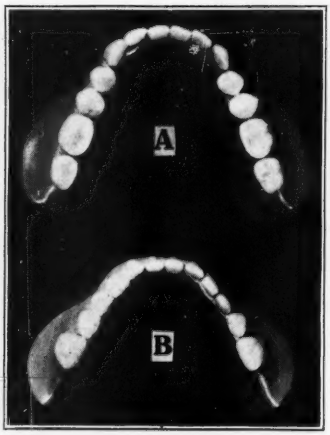

Fig. 9.—Two lower dentures. *A*, average lower denture; *B*, much less bulky denture for patient with tight lips and cheeks and large tongue. They exhibit the same features: (1) narrow arch in the premolar region; (2) wide buccal flanges; (3) room for the frenum linguae; (4) anterior lingual planes behind the bicuspids; (5) fairly vertical lingual surfaces in the first molar region; (6) posterior lingual rests which go under the tongue (not under the mylohyoid ridge) at the posterior extremities of the lingual surfaces; (7) all lingual surfaces looking inward and upward; (8) all buccal surfaces looking outward and upward; (9) vertical labial surfaces; (10) extremely narrow teeth, on denture *B* particularly.

In every case, the characteristic narrowing of the whole denture in the premolar region appears, in order to avoid its upsetting when the corners of the mouth are drawn in (contraction of the musculi cruciati modioli).

It is not possible in a short paper to discuss the subject fully, or even deal in detail with the lingual surface of the denture, or the sort of impression that is needed to facilitate this modeling. This has been done elsewhere[1]; but one further point may be considered: the narrow

1. Fish, E. W.: "Principles of Full Denture Prosthesis," London: J. Bale Sons & Danielsson, Ltd., 1933.

arch in the premolar region of the lower denture does not mean a narrow arch in the premolar region of the upper denture. The v-shaped strap in Figure 4 will lift a wide lower denture, but it will also lift a wide upper one, and thus, if the lower denture is reasonably narrow, and the upper one fairly wide, the modiolus will only lift the upper denture; which is, of course, an advantage.

An arrangement, therefore, like that in Figure 6 is often very valuable where the lower bicuspid is a single cusped tooth and occludes with the inner cusp of the upper bicuspid. In this way, not only is the arch of the lower denture kept narrow in order to escape the modiolus, but the stability of the upper denture is also increased by its being pressed upward and inward, and not upward and outward, as would be the case if the lower bicuspid occluded with the outer cusp of the upper bicuspid.

Figures 6-8 show transverse sections of stable full dentures in the first bicuspid, first molar and second molar regions, and incorporate certain additional points bearing on the modeling of the lingual surface.

It is felt that the purpose of this paper will have been served if it calls attention to the importance of the shape of the "polished surface" of the dentures, that this may not be left to the unguided effort of the mechanic in waxing up. It should be carefully modeled, and adapted to the cheeks and tongue as accurately as the impression and occlusal surfaces are adapted to the alveolar ridges and to the opposing dentures, respectively.

WHAT THE PHYSICIAN SHOULD KNOW ABOUT DENTAL PROBLEMS*

By JOSEPH A. POLLIA, M.D., Los Angeles, Calif.

THE dentist is, I believe, somewhat better informed in regard to the medical problems which concern his practice than is the physician about dental difficulties in their relation to medicine. It is not unusual to find dentists with a speaking knowledge of the chronic infectious processes, body nutrition, acid-base equilibrium and various other strictly medical facts. Most physicians and surgeons are not aware of the amount of medical information which the average dentist may possess, and therefore are inclined at times to treat a dentist's opinion regarding certain conditions without sufficient consideration. This attitude tends to create a state of either resentment or defense, neither of which encourages open-minded discussion of mutual questions. This is one of the chief obstacles to the proper exchange of opinions of interest to both professions which must be corrected before a full appreciation of individual difficulties can be obtained.

Physicians and surgeons must realize

*Read at a joint meeting of the Pasadena Branch of the Los Angeles County Medical Association and the Pasadena District Dental Society, Jan. 10, 1933.

that the dentist is the most highly trained specialist in the healing arts, because his college work and his entire practice deal with the oral cavity. No other professional men have shown the eagerness for the acquisition of knowledge by the promotion of postgraduate instruction and the organization of study clubs and programs which are not only didactic but also accompanied by practical demonstrations, in an endeavor that has been evident on the part of dentists to maintain the rank and file of the profession as close as possible to the finest standards established by its most prominent exponents. In a single instance, in 1921, in the little town of Vancouver, B. C., the Tri-State Dental Societies, composed of dentists from British Columbia, Washington and Oregon, paid over $15,000 to expert teachers for four days' instruction. I do not believe that any other professional society has ever spent a similar sum for an educational program.

Any group of individuals who display such interest and enthusiasm to maintain their standards, knowledge and practice of their work deserves serious consideration of their opinions, and we physicians should at least permit a dentist to decide what should be done whenever teeth are in question, instead of taking it upon ourselves, as we often do, to dictate not only the procedure but also who should carry it out. I admit that there are dentists whose decisions may not be correct or may not agree with what the physician believes is proper; in which case, these differences should be exchanged fairly and openly in the consultation room by both men before decisive action is taken.

The medical profession should realize that the most powerful incentive, and the traditional motive for the existence, of the dental profession is the saving of the teeth, because the human chewing apparatus has thirty-two teeth, none of which is interchangeable with the others; or, so to speak, thirty-two varieties, of one tooth each. The loss of any one of them throws an extra load on the remaining, and if, unfortunately, certain teeth are the victims, there is even a possibility of an entire upper or lower denture being destroyed. The dental effort, before the bomb of "dental foci of infection" exploded in its midst, was almost exclusively directed to this end. Therefore, one can readily see the reason for the battle almost unto blood which took place in their ranks after this fact was established, because, in one fell swoop, these recent discoveries threatened to upset the diligent efforts of years, which constituted most of the material accomplishments of the profession.

Now that dentistry has given consideration to the systemic effects of its work, its reason for being, namely, to save teeth, is no less prominent, but it takes a different form. Dental effort today is directed against the two most common and important menaces to the keeping of an efficient masticating machine; namely, caries, or dental decay, and pyorrhea. To this may be added a third one, the removal of teeth because of therapeutic necessity, in the treatment of certain chronic diseases.

When, through unfortunate happenings, such as accident or disease, teeth or portions of teeth are lost, the next consideration of this profession is their replacement. So the problems which the physician should realize in connection with dentistry are: (1) those connected with dental decay, (2) pyorrhea, and (3) restoration of lost masticating or tooth surfaces.

CARIES

Dental decay, or caries, is a disease which is as yet only imperfectly understood. Certain facts have been established regarding it which contribute greatly to the battle waged against it: (1) that the condition is more apt to occur before maturity, and (2) that, in some way, diet is a factor, either in its cause or in its control. Although older persons are not by any means immune, it is a problem of the earlier decades. The deciduous teeth are important because they enter into the foundation of the bony structure which is to hold the permanent members; therefore, the pediatrician is not free from some of the responsibility in the future dental efficiency of the individual.

The first permanent tooth is sometimes called the "six-year molar." This is a very misleading name, because it associates a definite age period, and in modern children, whose condition of health as a whole is so much superior to that which was general when these teeth were named, this tooth may erupt before the first of the deciduous teeth have been exfoliated. Therefore, if the general practitioner will bear in mind the large teeth which come up behind the last deciduous teeth and form the excess in the number "twenty," he will have rendered a great service to dentistry and to the patient by examining them when he looks for the diagnostic signs of tonsillitis, measles, scarlet fever and the other ailments which children are prone to suffer. Physicians should know that periodic roentgen-ray examinations, which are inexpensive, can be made by the use of the Raper bitewing film, and if this course is systematically pursued, caries can be detected at a time when the smallest amount of tooth substance is involved and, in some instances, alteration of diet is sufficient to prevent the extension of the condition of damage in that tooth and to others. The average dentist has information in his hands which, through the variation of certain foods and instruction in the hygiene of the mouth, may enable him to save a dental mechanism otherwise doomed to artificial upper and lower dentures.

PYORRHEA

In the matter of loss of the tooth, the topic of pyorrhea is to those of mature years what caries is to the younger person. "Pyorrhea" is an unfortunate term because old descriptions are associated with it.

The effect of this disease, if unchecked, is the same as that of decay, although the mechanism is entirely different. Caries destroys the tooth by disintegration of its substance; pyorrhea causes a loss of the bony support which holds the tooth in place, but does not affect its surfaces. The physician should realize, regarding pyorrhea, that it is just as important as a source of infection as the pulpless tooth, and my experience tends to convince me that this fact is often overlooked.

Pyorrhea, or periodontoclasia, as it is called by certain dentists, is a disease which finally attacks the fibers of the peridental membrane, which attaches the tooth to the alveolar process, and as this inflammation continues, it produces an absorption of the bone. The inflammation of the peridental membrane fibers seems to be associated with an initial disturbance of the blood supply of the gums, the periphery of the bony support and the peridental membrane itself. The conditions which provoke this altered circulation are many.

For instance, the mere shifting of the teeth as age advances, owing to the un-

even wear and certain congenital abnormalities in the patient's jaws, also the arrangement of the teeth, cause the forces of mastication to strike the opposing teeth at such an angle that the strain is distributed where the bony support of the tooth is weakest. The presence of poorly constructed inlays, the margins of which protrude beyond the surface of the tooth and permit food to pack under them, and bridges which are inaccurately balanced and throw more load on one of the supports; certain systemic diseases and errors in metabolism which cause the deposit of serumal calculus around the necks of the teeth, all of these have to be considered in the management of pyorrhea.

It is a great satisfaction to be able to state that, unless the absorption of bone is too extensive, the average competent dental practitioner can, by the gentle use of instruments, instruction in diet, the recognition and correction of defects in restorations and the adjustment of the articulation of the teeth so that they receive the stresses of mastication in the proper areas, save the teeth of many persons; and, above all, after this has been accomplished, by instruction in the proper method of brushing the teeth, prevent the recurrence of the disease or retard its spread.

REMOVAL OF DISEASED TEETH FOR THERAPEUTIC PURPOSES

Since the advent of the knowledge that pulpless teeth and those affected with advanced pyorrhea may be the cause of certain chronic diseases, there has come a new aspect in the maintenance of a normal masticatory machine or apparatus—namely, that these teeth have to be removed as a part of the program in the management of these diseases—which brings us to the important consideration of the pulpless tooth, since this particular condition has been the center of the most active discussion.

Dentists are fairly unanimous in the agreement that when a pulp is removed from a tooth, it becomes a point of diminished resistance to bacterial invasion. At the present time, it is quite safe to say that the removal of a normal pulp from the tooth is rarely if ever practiced, but as long as children will meet with accidents which break off a portion of the crown of certain teeth, and until periodic dental examinations become a universal habit and so prevent the progress of decay to the point where the pulp becomes affected, situations will arise wherein the diseased pulps, by reason of the above-named influences, will have to be removed in order to make possible certain desirable developments in the jaws.

There are still alive a large number of people who enjoyed the best which dentistry had to offer in earlier years and in that period, in order to assure more satisfactory restorations or to prevent the loss of a tooth, the removal of pulps and root-canal treatment were practiced extensively.

Because of the influence which such teeth may have on systemic diseases, it often becomes a question of whether they should be removed or retained. This happens to be one of the points wherein the physician must determine whether the disease which he wishes to treat can derive benefit from the removal of these teeth, and whether the particular dentist who has the case in charge is convinced that, in his experience, such a procedure is justifiable in that case. The physician should understand that there is no rule of thumb in this matter, that even the most radical and conservative opinions regarding pulpless teeth are tempered by certain exigencies which

the specific case may present. If there is disagreement between the physician and dentist as to the procedure with respect to pulpless teeth in an individual case, further consultation should be requested.

DENTAL RESTORATIONS

A dental restoration is the artificial replacement of lost teeth or portions of a tooth surface, and all such objects must conform to four requirements: (1) a high degree of mechanical efficiency; (2) strict accordance with physiologic laws; (3) cost within the means of the individual, and (4) a good appearance. The first two concern the operator, the latter two the patient. With the possible exception of the second, all of these standards must be met or the restoration will be impractical.

In this phase of dental practice, we gain an insight into the remarkable versatility of dental operators and the great variety of subjects which they must study in order to perform their work. The only department in medicine that approaches dentistry in this respect is that of orthopedic surgery. A dentist must know about stresses and strains, casting, the peculiarities of investment materials, wax, plaster of Paris, gold and its alloys, the phenol substitutes for rubber, ceramic powders, modeling compound, expansion and contraction of substances, in addition to the skill to carve recesses that hold fillings, make anatomic counterparts and perform surgical procedures on the hardest tissues in the body without causing an injury that may produce irreparable damage to the tooth, bone or gums. In addition, he must have esthetic sense, ability to match colors to reproduce under artificial conditions all of Nature's moods as displayed in the teeth, to say nothing of gentle manual dexterity and a magnetic personality.

Restorations may be divided into four groups: (1) dentures, (2) bridgework, (3) crowns, and (4) surface fillings. All restorations which are removable are classified as dentures and there are two kinds: full, in which all of the teeth of one jaw are replaced, and partial, in which some teeth, even one, may remain.

These replacements offer a large variety of interpretations and some of the partial ones may consist of as few as three teeth. When the space to be filled out represents so few, the prosthesis goes under the name of bridgework.

There are also two kinds of bridges: the fixed, which remains in the mouth at all times; and the removable, which is capable of being cleaned outside the mouth and is held in place by means of clasps or bands, or male and female attachments. Of course, such appliances give rise to numerous problems, in the physics of mastication, and also, whichever type of attachment is used to hold a removable or fixed bridge must not endanger the life of the tooth which is used as an abutment, because modern dental technic demands that no living tooth, even for the purpose of restoring lost members, be so injured that the pulp may die.

Crowns and fillings virtually restore the same type of loss, and the difference is only in degree. The crown replaces the entire external surface of the tooth; the filling, only a part of it.

There are two types of crown, the ceramic, or porcelain, jacket crown, and the metallic, of which the most common one is the cast crown. In this particular phase, dentistry has made remarkable progress, since it has found a way by which it may replace the entire ex-

ternal portion of the tooth without the accompanying errors in fit which made the gold shell-crown such a prolific source of infection and a common cause of pyorrhea.

Restorations of less than the entire tooth surface, or fillings, are made with cement, synthetic porcelain, baked porcelain or metal. Even the restoration of small portions of lost tooth surfaces are not without their danger, for if the materials which are used are improperly embedded, do not fit correctly and do not protect the dentin which supports them so that no progressive changes take place in the chemical contents of the materials and reach the pulp, it may become diseased and die.

Very ingenious indeed are the many ways in which the partial restoration of tooth surfaces is accomplished, as, for example, by the use of the synthetic porcelains which defy detection. The tremendous work toward the perfection of baked-porcelain inlays shows the ambition of the dentist to make a restoration less offensive to the eye, as well as efficient and durable.

There are two types of metallic restorations, the pliable and the hard. In the pliable fillings, the metal is in a ductile state when applied and acquires the necessary compactness by packing and manipulation. The two most popular types of pliable fillings are the amalgam, which is produced by quicksilver and is of great value because of its ready adaptability and reasonable cost; and the gold foil, beaten fine gold being packed into the cavities. The cast inlay is the best known type of hard restoration. It involves many more principles than just the technic of casting.

Although I have mentioned hardly more than the various methods which dentistry uses in order to keep the human mouth in a state of health and of highest masticatory efficiency, it is impossible to conceive the tremendous effort and thought which have been expended in the development of methods to make this possible. Thus, when we assign to the dentist the problem of repairing a mouth, little do we realize what that means to the dentist who is anxious to make his work conform to the highest standards that have been established.

I have not included in my survey of what a physician should know about dental problems any statement about oral surgery, which is a department of dentistry more or less understood by us all; but something should be said about orthodontia, the practice of directing the arrangement of teeth in such a way as to make them conform to the normal standards for the shape of the jaws and the articulation of the teeth. The intelligent application of this art, more generally and universally recognized, will do a great deal toward building up the future dental health and facial beauty of our people, for the orthodontists are able to make teeth grow so that they approach the architectural arrangement which Nature intended that they should have, and, by so doing, not only improve the appearance of our race but also make it possible for the forces of mastication to strike where the teeth have the best bony support, and in this way cut down the ravages of pyorrhea.

I have, I hope, made it clear that the dentist has no fewer troubles than the physician, even though they do not exist above the palate or below the tongue, and they are so numerous that a liberal education in dentistry is necessary in order to appreciate them fully.

Therefore, the quickest and best solution which the physician has to these oral problems, when the teeth enter into the consideration of a disease, is: (1) to

have confidence in the dentist to whom the health of the patient's mouth has been entrusted; (2) to meet this individual in consultation as an equal; (3) if he disagrees, to ask for other consultants, and (4) to consider that for almost every tooth that is lost, an artificial one must be put in its place to protect those teeth which remain, and that this entails an extensive and thorough knowledge which only an individual such as the dentist, who has devoted all of his training and most of his life to the subject, can have and can apply.

209 South Lake Street.

THE FLOOR OF THE MAXILLARY SINUS AND ITS DENTAL, ORAL AND NASAL RELATIONS*

By WALLACE F. MUSTIAN, D.D.S., M.S.D. Warrenton, N. C.

A REALIZATION of the importance to the dentist of an accurate knowledge of the relations of the maxillary sinus floor prompted this study.

Possibly no part of our bony structure presents as many anatomic variations as the maxillary sinus. It seems that almost any variation in size and shape consistent with the boundaries of the maxilla and certain articulating bones including the teeth may exist. With this in mind, this work was primarily undertaken for the purpose of making and recording anatomic observations that would be of value to the dentist, oral surgeon and rhinologist. Standardized operative procedure in the presence of marked anatomic variations may have unpleasant and even dangerous results.

The object of this study was to determine the relations of the floor of the maxillary sinus, and the possible types and frequency of variation from the usual in the floor; also, the possible application of this knowledge to practical purposes. (Fig. 1.)

For the purpose of this research, 4,000 observations were made on 100 human maxillary sinuses. Material was obtained from the anatomic laboratory of Northwestern University Dental School. The subjects, all past middle life, had had practically no dental care except an occasional emergency extraction.

No attempt was made to so select the specimens as to show certain specific conditions, as we wished to show average conditions.

All of the specimens were well preserved sagittal sections of the face bones, excluding the mandible. Numerous cuts and sections were made at different locations, thereby exposing the sinus in the most advantageous locations, and showing its relation to the nasal fossa, palate, zygoma, concha, median and lat-

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*Abstracted from a portion of a thesis submitted to the faculty of Northwestern University Dental School in partial fulfilment for the requirements for the degree of master of science in dentistry, August, 1932.

eral walls of the nose and the alveolar ridge, also the tooth relations to the floor. (Fig. 2.)

The subject of the maxillary sinus is not new. Galen, a Greek physician, had knowledge of it in the years 139-201. N. Highmore, an English anatomist, in 1851, gave what was considered the first description of the cavity. He discovered this sinus by the extraction of a left cuspid tooth. As this tooth rarely comes in contact with the floor, the sinus in this case must have been exceedingly large.

Cowper, in 1701, exposed the sinus through a tooth socket, and later the mode of making entry into the sinus through a socket was given his name. Zukerkandl was next,[1] in 1893, to make a thorough study of the sinus. Since then J. Parsons Schaeffer,[2] Cryer,[3] and Skillern,[4] with others, have given the maxillary sinus careful study.

Fig. 1.—Maxilla. A vertical cut has been made through the center of the teeth and alveolar ridge exposing the floor of the maxillary sinus and showing its dental relations. (Actual size.)

ANATOMIC DESCRIPTION OF FLOOR OF MAXILLARY SINUS

The descriptions by these writers of the maxillary sinus, and especially of the floor, is brief. They give no indication of the variability of the floor. Few maxillary sinuses correspond exactly to the classic presentation found in most textbooks.

Morris'[5] description of the struc-

1. Zukerkandl, E.: Normale und Pathologische Antomie Der Nasenhole, Vol. 1, 1893.

2. Schaeffer, J. P.: Sinus Maxillaris in Man, Am. J. Anat., 10: 313-368, 1910.

3. Cryer, M. H.: Internal Anatomy of the Face, Philadelphia: Lea & Febiger, 1916.

4. Skillern, R. H.: Accessory Sinuses of Nose, Philadelphia: J. B. Lippincott Co., 1920.

5. Morris, Henry: Human Anatomy, Ed. 6 (C. M. Jackson, editor), Philadelphia: P. Blakiston's Son & Co., 1921.

ture of the floor of the sinus varies in no great essential from that found in other textbooks on anatomy:

The floor of the sinus is usually very uneven due to the prominences corresponding to the roots of the molar teeth. In most cases the bone separating the teeth from the sinus is very thin and occasionally the roots project into it. The teeth which come into closest relationship with the sinus are the first and second molars. But the sockets of any of the teeth lodged in the maxilla may, under diseased conditions, communicate with it. As a rule the cavity of the sinus is single, but occasionally specimens are seen in which it is divided by long septa into chambers, and it is not uncommon to find recesses separated by bony processes.

It was found that, topographically, the floor of the sinus usually corresponds to one side of a kidney. If one end were somewhat sharpened and the other flattened, the sharpened end would be like the anterior part of the sinus floor, while the flattened end would resemble the posterior; the hilum, or concave portion of the kidney, the nasal

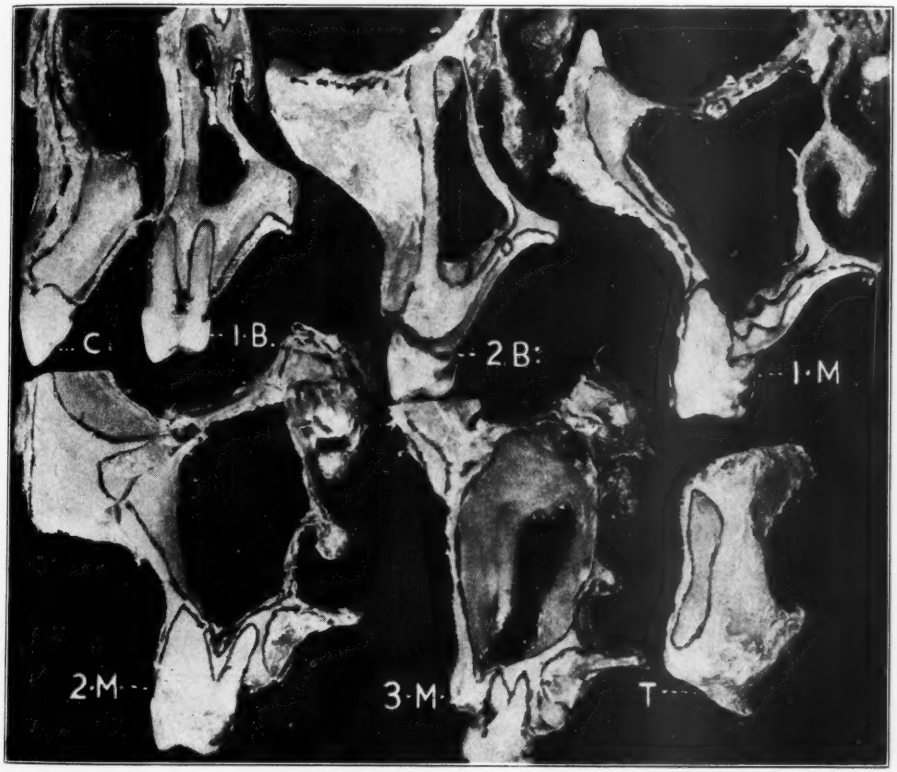

Fig. 2.—Frontal cuts through a maxilla, between the teeth, exposing maxillary sinus and showing relations to teeth, processes and adjacent structures at different locations; position from front looking backward. *C*, cuspid; *B*, bicuspid; *M*, molar; *T*, tuberosity. (Actual size.)

wall; the lateral border or convexity fitting roughly into the zygomatic prominence. The lowest part of the floor was usually found to be over the second molar area. (Fig. 2.) From this point the floor rises more abruptly in the anterior direction than it does in the posterior. It is usually oval from side to side, but occasionally where it dips down between the buccal and palatal roots of the molars or into a sharp endentulous alveolar (ridge) process, it may be more constricted or v-shaped. It may occasionally burrow under the floor of the

Fig. 3.—Floor of a maxillary sinus, showing partial septums over edentulous area; also, deep pockets and pathologic sinus, condition arising from infected root, indicated by arrow. (Actual size.)

nose, leaving the lateral wall of the nose to form a distinct ledge. (Fig. 3.)

Partial septums forming gothic-like arches may arise from the nasal and lateral walls and form deep pockets or depressions in the floor and alveolar process. The resorption of the floor of the sinus about the roots of the teeth or between the bifurcations of the molar teeth often leaves the roots of these teeth projecting into the floor in conical-shaped projections or distinct eminences on the walls. In a few cases, no bone was observed over portions of the roots. They were covered only by the mucoperiosteum lining the cavity. (Fig. 4.)

In our study, there was no landmark to aid in determining the form or size of the antrums before they were exposed. No definite reason can be given for their size and shape. The shape of

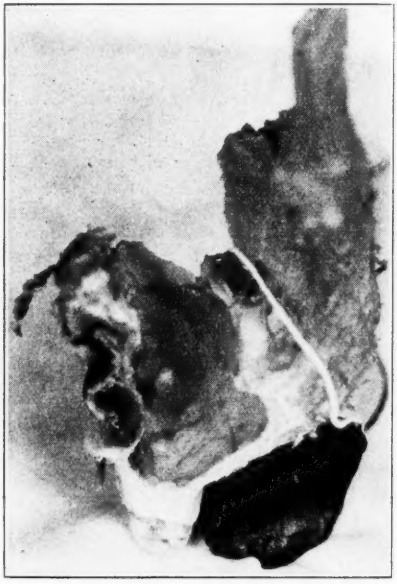

Fig. 4.—Roots of all molars extending into floor of maxillary sinus as conical projections, some as high as 10 mm.; palatal root of third molar covered by mucoperiosteum in places only.

the palatal arch gave no information as to the formation of the sinuses. Often, in heads showing narrow constricted arches, the sinuses were found to be unusually large, and even extended into different processes to variable depths.

Underwood[6] has stated that "a surgeon can pronounce with tolerable accuracy the size of the cavity, the level of the floor, and the presence and extent of septa." He does not explain his method of arriving at this deduction.

LIMITS OF THE FLOOR AND ITS TOOTH RELATIONS

Our observations confirm those of Shea,[7] Jackson,[8] Boyne,[9] Schaeffer,[2] Zukerkandl[1] and others relative to the teeth in the sinus region. The question of what teeth are directly under the floor of the maxillary sinus is an important one. It was found that all the teeth in the true maxilla could be under the sinus region, but seldom does this happen. In other words, according to our observations, the sinus floor would extend in an anterior-posterior direction from a point halfway between the lateral incisor and cuspid to the infratemporal wall (heel of the tuberosity) of the maxilla. In the specimens studied, no sinus floor extended so far forward as the lateral incisor, but three specimens came forward to a space halfway between the lateral incisor and cuspid. Two of these were edentulous.

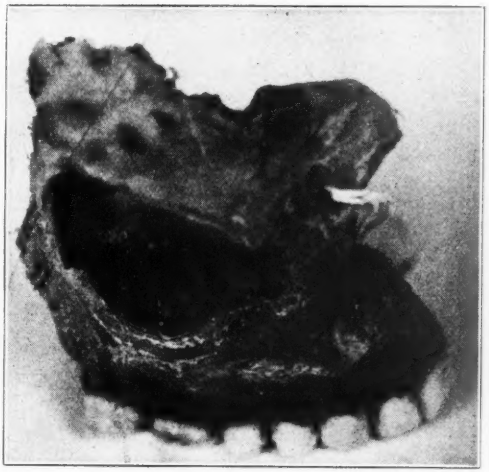

Fig. 5.—As in 75 per cent of cases, sinus floor beginning between cuspid and bicuspid. (Actual size.)

In the remainder of the specimens, the sinus cavity began anteriorly in the following order, as compared to the teeth: Twenty-six times it began over the cuspid, sixteen times halfway between the cuspid and the first bicuspid, ten times at a point over the first bicuspid, twenty-three times between the

6. Underwood, A. S.: Some Recent Researches on Anatomical and Pathological Conditions of Maxillary Sinus in Relation to Teeth, J. Laryngol., November, 1908, p. 260.

7. Shea, J. J.: Influences of Periodontal Infection on Nasal Sinus, J.A.D.A., 19: 251-255 (Feb.) 1932.

8. Jackson, Chevalier, and Coates, George: Nose, Throat, Ear and Their Sinuses, Philadelphia: W. B. Saunders Company, 1921.

9. Boyne, H. N.: Study of Forty-Three Maxillary Sinuses, Northwestern University Dental School Master Thesis, 1924.

bicuspids, eight times over the second bicuspid, eleven times between the second bicuspid and first molar and three times over the first molar. In 75 per cent of cases, the sinus floor begins between the cuspid and the second bicuspid; in 25 per cent of cases at points from the second bicuspid to the first molar, except for the three cases in which it began mesially from the cuspid.

The posterior wall of the sinus ended at the infratemporal wall of the maxilla in 97 per cent of the specimens. This wall was found very thin, in most cases almost paper thin. The deduction from these observations would be that the sinus floor usually extends from the second bicuspid to the infratemporal wall of the maxilla. (Fig. 5.)

Our smallest sinus was in an edentulous maxilla. It began between the bicuspid area and ended just distally from the second molar. In two specimens, the posterior wall of the sinus ended directly over the third molar.

TOOTH RELATIONS TO THE FLOOR

The position which the roots of the teeth occupied as regards the floor of the sinus varied considerably. For example, the apical ends of the roots varied as much as 20 mm. in their extremes as compared to the floor of the sinus. Certain specimens will show as much as 10 mm. of process between the apices of the roots of the teeth and the floor of the sinus. (Fig. 6.) Other specimens will show where the floor of the sinus descended to the bifurcation of the molars leaving the roots of the teeth 10 mm. above the floor in the walls of the sinus. Any degree of variation or difference on either side of these extremes is possible. (Fig. 6.)

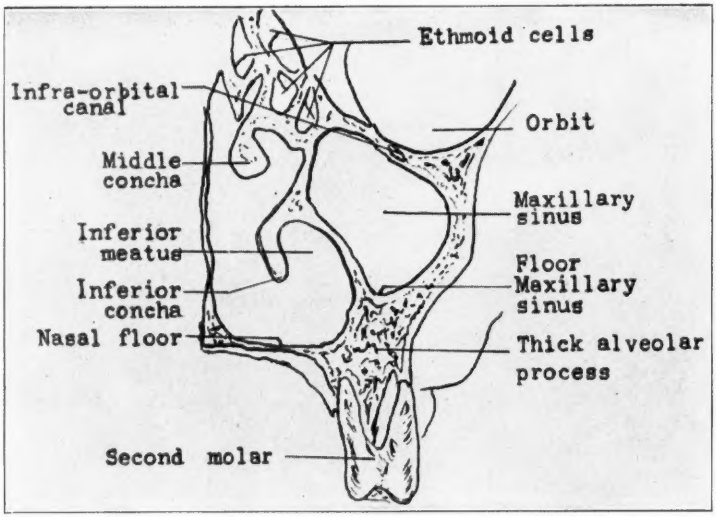

Fig. 6.—Glass tracing showing highest maxillary sinus floor above nose—6 mm.; extra thick alveolar process, wide nasal fossa and thin palatine process; a favorable case for naso-antral drainage. (Actual size.)

It was found that the second molar

roots occupied positions in the walls of the sinus more frequently than any other tooth (Fig. 7); more than twice as frequently as the roots of the second bicuspid and the first and third molars. The cuspid and first bicuspid roots did not appear in the walls of the sinus in the specimens. The second bicuspid was found in the palatal wall twice and in the buccal wall, five times. The order of the roots of the other teeth as to their positions in the walls of the sinus

ical projections in the floor of the maxillary sinus than did any other tooth. It was found that the second molar formed forty-six prominences; the third molar, twenty-two; the first molar, sixteen, and the second bicuspid, eleven. (Fig. 4.) The cuspid and the first bicuspid were not extended into the sinus as conical projections. These mounds, or elevations of the roots, seemed to be caused by resorption of the floor of the sinus about the roots of the teeth. Some-

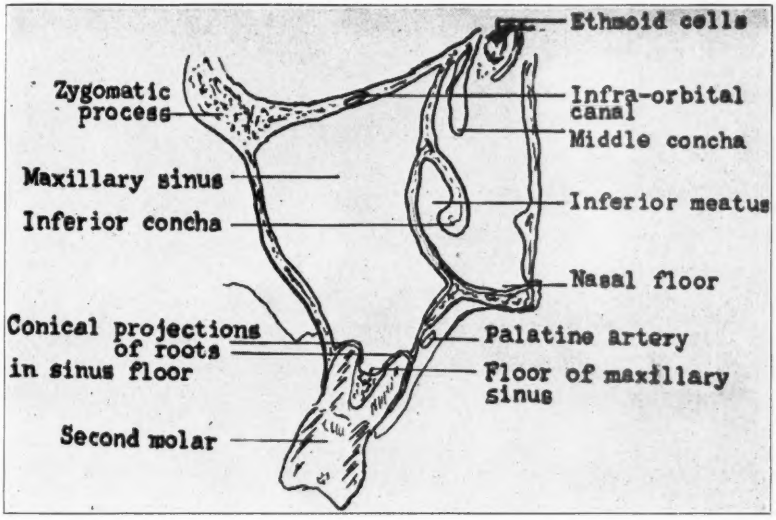

Fig. 7.—Glass tracing showing maxillary sinus floor 16 mm. below nasal floor. There is pneumatization of all processes. This is not a favorable case for naso-antral drainage. The teeth bear intimate relations to the mucoperiosteum of the sinus floor. (Actual size.)

above the floor are: the second molar, the first molar and the third molar, respectively. The average height that the palatal roots appeared in the palatal process was 3.9 mm. The thin cortical bone lining the maxillary sinus was in most cases the only bone separating these roots from the mucoperiosteal lining of the sinus.

The second molar formed more con-

times, the resorption of the wall of the sinus would take place on three sides of the root only, the roots of the teeth left on the walls remaining as distinct pillow-like projections. At other times, the resorption of bone apparently took place equally on all sides of the roots, leaving finger-like projections from the floor with little or no cortical bone covering them at places. (Fig. 7.)

The nerves and blood vessels course down from the walls and rise up in a funnel-like manner, entering the apex of the root.

PNEUMATIZATION OF THE MAXILLA

Pneumatization of the maxilla and its processes varies considerably. This variation governs the size of the sinus. It was found that the sinus could extend into any of the processes of the maxilla and even into the zygoma, concha or palate bone. The most frequent extension was into the alveolar and zygomatic processes. (Fig. 8.)

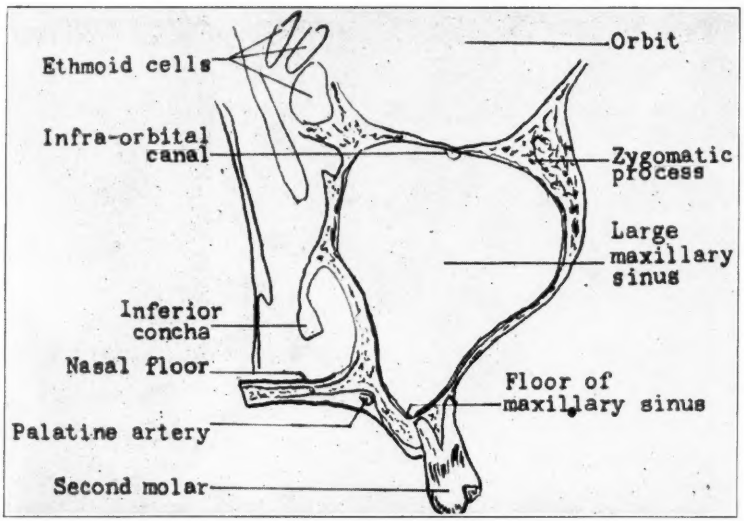

Fig. 8.—Largest maxillary sinus in 100 specimens. The excessive pneumatization and tooth relations are to be observed. (Actual size.)

Blair[12] makes the statement that he has seen the palatal process pneumatized to the midline. In the 100 cases examined in our study, only one extended as much as 7 mm. under the floor of the nose, or two-thirds of the distance to the midline. This specimen also showed a large canal for drainage of the anterior ethmoidal cells directly into the maxillary sinus. (Fig. 9.)

This peripherial enlargement of the cavity often leaves partial septums, bony ridges and projections of varying heights on the floor of the cavity, distinct pockets or depressions thus forming in many cases.

SEPTUMS ON THE FLOOR

In a great percentage of the cases, some obstruction was found on the floor of the sinus. The septums were invariably found over the teeth, running normally in a mediolateral direction. (Fig. 12.) The septums averaged 4.2 mm., and some were found as high as 10 mm. It is evident that a pocket on the floor of at least 10 mm. might occur. Dependent drainage or the removal of

12. Blair, V. P.: Surgery and Diseases of the Mouth and Jaws, Ed. 2, St. Louis: C. V. Mosby Co., 1917.

a foreign body from one of these pockets offers a real problem. Realizing this, Chevalier Jackson[8] stated that "these compartments often require individual treatment." (Fig. 3 and 10.)

In an analysis of the findings, it was determined that two thirds of all septums were located over three teeth. The order of frequency was: the second molar, the first molar and the second bicuspid tooth, respectively.

Cryer[3] has been unable to find complete septums in the antrums, although Morris,[5] Boyne,[9] W. Grube (quoted by Zukerkandl[1]) and others report finding the maxillary sinus thus divided. Schaeffer[2] believes that multiple maxillary sinuses are probably developed from two primary pouches or extensions from the middle meatus of the nose.

In the specimens studied, one sinus was divided into two distinct and separate cavities, except for a small opening in the center of the septum about the size of a pinhead.

If the septums on the floor of the sinus are the result of unequal resorption of the floor about the root, one should find the root of a tooth usually located in the septum or directly under it. (Fig. 12.)

CHANGES IN THE FLOOR AFTER EXTRACTION

From the observations made, one arrives at the conclusion that the floor of the maxillary sinus is not materially affected by the removal of the teeth. It was found that the floor contracts in width and length, and the conical projections recede. The floor does not appear to be raised or lowered nor does the partial septums always disappear in edentulous cases.

It appears that the alveolar process is

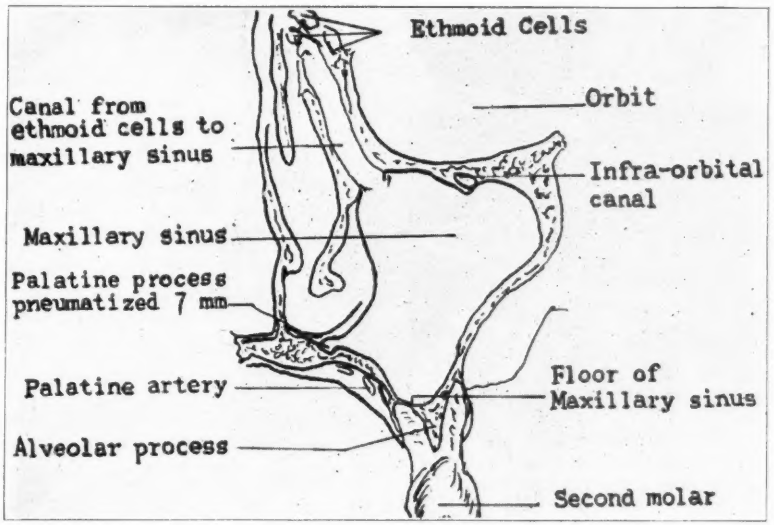

Fig. 9.—Excessive pneumatization into various processes; ethmoidal cells draining directly into maxillary sinus. The sinus floor extends under the floor of the nose 7 mm. (Glass tracing, actual size.)

affected by tooth extraction, because, apparently, its chief purpose is to support the teeth. After their removal, its function ceases; therefore, the tendency is for resorption. Some of the specimens showed only 2 or 3 mm. of tissue remaining of what was formerly the alveolar ridge. This resorption went on apparently without changing the position or contour of the floor of the sinus. (Fig. 11.)

ALVEOLAR ROUTE OF ENTRY INTO SINUS

Exploring the antrum by the alveolar route, there was found to be on the average 10.3 mm. of bone between the floor of the sinus and the alveolar crest,

Fig. 10.—Specimen shown in Figure 5. The bony septums on the floor and the lateral outline of the maxillary sinus are to be observed.

in persons having teeth in the molar region. In the endentulous, about 8 mm. of bone is encountered. The extremes are quite variable. In the full denture group, the thickest was 19 mm., the thinnest 3 mm. Compared to those of the endentulous group, the thickest was 21 mm., the thinnest 2 mm. The deductions are that the alveolar route of entry into the maxillary sinus is not desirable, because of variations in thickness of the alveolar process. Other reasons are the irregularity of the floor and the increased probability of mixing oral flora with those of the nose already found in the sinus.

RELATIONSHIP OF THE CANINE FOSSA TO MAXILLARY SINUS

A depressed canine fossa which seems to approximate the lateral wall of the nose may be deceptive. It has been found in such cases that the sinus may extend forward in a tonguelike extension under the canine fossa, or perhaps it may stop abruptly just distally from the fossa. To enter the maxillary sinus through the canine fossa, the anterobuccal surface of the zygomatic prominence is the preferable point. The opening should be made high enough to avoid injury to the superior dental plexus of nerves and the apices of the teeth. This point is below and distally from the infra-orbital foramen. No injury would result to the vessels and nerves emerging therefrom. Entrance gained here would expose the sinus in a most advantageous position, since the cavity is wider and is nearer the center. This position would give visibility and access to most of the septums and pockets located on the floor of the sinus. (Fig. 10.)

A fairly dependable theorem is that when the canine fossa and the lateral wall of the nose are closely approximated, the cuspids and bicuspids do not bear a direct relation to the maxillary sinus. In such cases, a broach pushed through the teeth may penetrate the canine fossa or the lateral wall of the nose. An attempted opening into the sinus from the canine fossa would usually result in an opening into the nose.

DRAINAGE OF THE SINUS

For dependent drainage of the sinus, the customary naso-antral window is not always sufficient. For this method to work satisfactorily, the floor of the sinus must be on a level with or above

the inferior meatus of the nose. (Fig. 6.) Blum[10] says: "The lowest part of the sinus is usually on the same level as the nasal floor." A. Logan Turner[11] says: "After the extraction of the permanent teeth, the floor of the sinus occupies a lower level than that of the nasal floor." Chevalier Jackson[8] made the statement that "the usual point of entrance from the inferior nasal fossa is an important factor when dependent drainage is considered because generally the floor of the sinus is caudal to that of the nose, and often half of the extent of the sinus is below that of the inferior meatus."

J. Parsons Schaeffer[2] believes that "the relation of the floor of the sinus to that of the nose depends largely upon the degree of hollowing out of the alveolar process." Boyne[9] observed that the floor of the sinus was below that of the nose in 93 per cent of his forty-three specimens. In the specimens studied, the floor of the sinus was below that of the nose in seventy-nine cases. (Fig. 7.)

OTHER OBSERVATIONS AND CONCLUSIONS

The tuberosity of the alveolar process was usually the most porous part of the alveolar border. It usually could be punctured with little difficulty by a sharp instrument. This process was found to be supported by the pterygoid process of the sphenoid bone in 53 per cent of the specimens. The porosity and lack of support explains why the tuberosity is often fractured during the extraction of the maxillary third molar. (Fig. 2.)

Only three unerupted teeth were located in the tuberosity. They were third molars. In each instance, their roots

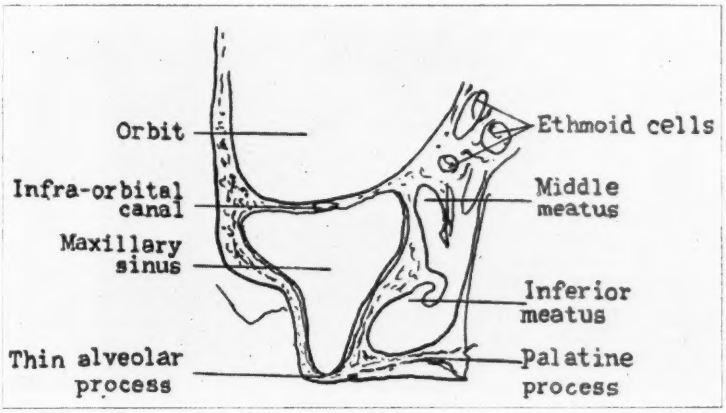

Fig. 11.—Edentulous maxilla showing only 2 mm. of tissue remaining between floor of maxillary sinus and oral cavity; alveolar ridge on level with hard palate. (Glass tracing, actual size.)

10. Blum, Theodor: Oral Surgeon's Position in Diseases of Maxillary Sinus, Internat. J. Orthodontia, 8: 295 (May) 1922.

11. Porter, W. G.: Diseases of the Nose, Throat and Ear, Ed. 4, (A. L. Turner et al., editors), New York: William Wood & Co., 1924.

were extended into the floor of the sinus as conical projections; one to the extent of 10 mm. (Fig. 4.) The removal of these teeth would have exposed the sinus cavity or left only a thin membrane separating the socket from the sinus.

The Cowper method of entering the antrum by the extraction of a tooth and through its socket is somewhat obsolete.

Fig. 12.—High septum over second molar. The roots of the molars extend into the sinus floor as conical projections, some covered only by mucoperiosteum. The pathologic sinus from the palatine root of the second molar leads to the floor of the maxillary sinus, indicated by the arrow. There is no bone over the palatal root of the third molar. (Actual size.)

We must not forget that the antrum is often accidentally exposed by extraction of teeth in its vicinity. This is especially true of the second molar. This tooth, as a rule, is in a closer relationship to the sinus than are other teeth. (Fig. 7.)

It is possible for the whole cortical plate of bone over this tooth to come out in its extraction. In fact, this happens in many instances, because the intervening bone over the bifurcation of the fangs is sometimes paper-thin and fractures easily. Unless disease is present, such an accident is usually of no consequence. The lining membrane of the sinus would not often be punctured, unless careless probing or needless curettement was indulged in.

In the extraction of the teeth that are well up in the walls of the sinus, extreme care is necessary in case of root breakage. It is possible to force the root fragment up between the mucoperiosteum and the sinus wall, or even into

the sinus. If the floor is covered by pockets or deep depressions, the root could become lost and require a radical operation for its removal. (Fig. 12.)

Teeth occupying such intimate relations to the floor of the sinus would require special care and consideration in the treatment of disease and in repair. The roentgenogram gives us more information relative to the structures adjacent to the maxillary sinus than perhaps any other clinical means of study. One cannot interpret what is written on a film unless he knows normal anatomic structure, its variations and how the normal changes with disease.

From the anatomic facts as found and presented, is it not surprising that maxillary sinusitis may be of dental origin in many cases? Of the 100 sinuses examined, fifty were diseased. Twelve were positively identified as being in direct continuity with dental disease. (Figs. 3 and 12.)

CONCLUSION

Since the maxilla is built about the maxillary sinus a better knowledge of the relations of this sinus and its floor will enable one to understand the surgery of the maxilla and its alveolar border. This includes the extraction of the teeth of the upper jaw, neuralgia and foci of infection. This is especially true of disease originating in the teeth or alveolar border, but involving the sinus. Correct anatomic knowledge of this cavity is of vital importance for proper interpretation of roentgenograms.

WHAT COURSE SHALL DENTISTRY FOLLOW IN COPING WITH ITS MAJOR ECONOMIC PROBLEM?*

By C. N. JOHNSON, L.D.S., D.D.S., Chicago, Ill.

IN dealing with the entire problem of dental economics, the statement might as well be made at the very beginning that no system of economics will ever function 100 per cent for every individual in the profession. It is not in accordance with human nature or human experience.

Yet many of our writers and speakers seem to proceed on the theory that a certain formula promulgated in accordance with their own individual point of view will suffice to turn an economic failure into an economic success, something like a "presto-change" process or sleight-of-hand performance. The sooner disillusionment regarding this idea is established in the minds of the profession, the better it will be for the economic welfare of those most in need of economic succor. The fact is that no formula worked out by the most astute economist is worth the paper on which it is written till it is subjected to the crucial alembic of actual experience in a given case or given situation.

Bainbridge Colby, former Secretary of State, has said: "I do not wish to be understood as speaking derogatorily of economists in general; one thing,

*Read before the Chicago Dental Society, May 16, 1933.

however, will not be disputed and that is that the chief concern of economists is to refute all other economists." This is an arraignment to which I hesitate in whole to subscribe, even though I cannot escape a certain skepticism regarding the virtue of some of the measures suggested by a few of our dental economists of the recent past. I think that economists have performed a very worthy service in the world, and I cannot but wish that the rank and file of our profession had given more heed to sound economics in the conduct of their affairs.

And let me go straight to the point in my approach to this question with the assertion that if a man is economically a failure, it is usually his own fault. Barring physical handicap, ill health or calamity of some sort, no man has any excuse for not being able to provide for his individual welfare, as well as for that of his family or those dependent on him. In other words, no man can lay on society at large the onus of his own economic failure. The legitimate opportunities for securing the foundation of at least a modest economic competence are so widespread in this country that there is something wrong with a man if he fails to achieve this much, and the sooner each individual has this fact brought pointedly home to him, the better.

I am only too conscious of the appalling exigencies of our lives that sometimes overpower individuals and engulf them in a well-nigh hopeless morass of unexpected and often unexplained difficulties, and for such emergencies I have the most profound and compassionate regard and sympathy, but for the ordinary every day "run of the mine" affairs of life, I can see no reason that an able bodied man cannot husband his resources and keep his head above water.

Let each man look himself frankly in the face, even if he has to use a magnifying mirror, and try to analyze wherein he has failed to make use of the opportunities that are everywhere presented to him. It will serve him a better purpose than it will to rant at fate and lay the burden of all his ills at the door of someone else. Individual responsibility is one of the greatest needs of the hour, and this relates to other affairs of life as well as to material matters. It is something especially to think about in the present financial stress to which our citizens have been subjected.

One of the most demoralizing agencies that have come into our social fabric in recent years is the dependency that has been fostered among the people through our generous but ill-advised efforts at philanthropy, whereby able bodied men have been pauperized by the receipt of gratuities that have been lavished without due discrimination; and it is a matter for much commendation that the various committees in the Chicago Dental Society during this period have sought to minister to the dental needs of the poor without permitting, to any great degree, the abuses that so frequently obtain in movements of this kind when not safeguarded by wise and discriminating counsel. It is not easy to dispense aid without doing harm, but this the committees have endeavored to do.

If, then, economic success is largely an individual problem, it may be well for us to consider somewhat specifically the various agencies that make for or against this kind of success, recognizing as we must that there is other success in life aside from that to be obtained by the accumulation of money. We all know of instances wherein a man has made a distinct contribution to the science and art of his calling without enriching him-

self in any material sense, but this is not a subject for present consideration.

We have just said that there is no specific formula for economic success, and now we must go one step farther. We might as well at once face the fact that there are individuals in life, among whom unfortunately we may find some in the dental profession, that have not fundamentally in their makeup the elements of economic success. But lest this may seem an altogether somber shade to throw on the theme, I hasten to brighten it with the thought that, while the demands of dentistry are somewhat exacting, and while economic success is not always possible, the problems of dental practice — even the economic problems—I cannot but feel, are more amenable to solution than are those of most callings. In other words, I think that the major problems in dentistry are largely of a character that may be cultivated by individuals of average intelligence. It is for the most part a matter of application.

One of the greatest handicaps to success in the practice of dentistry is inefficiency, a failure to function properly and acceptably in our technical procedures, whereby too much bungling is apparent and too much waste of time is manifest. Time is one of the essential entities of a dentist's capital, his real stock in trade out of which he makes his earnings. Wasted time is therefore a great drag on a practitioner's earning powers, and no waste of time is more apparent or expensive than that involved in false motion or lack of system. While the marvelous development of our technical skill is one of the glories of modern dentistry, and while certain individuals are noted for the precision and rapidity with which they execute their various operations, we may logically admit that the rank and file of the profession do not often enough perform their everyday work with economic profit to themselves or with noteworthy satisfaction to their patients. It will probably shock you when I affirm that the average porter in a Pullman sleeper shows a higher order of system and efficiency in making up his berth than does the average dentist in filling a cavity in a tooth. Not that there is anything comparable between the exactions of or qualifications necessary in making up a berth and filling a tooth, but the porter goes at his duties in a more expeditious manner and with less waste motion than do many of those that I see operating at the chair.

Inefficiency of technical procedures, or what is sometimes slightingly referred to as the "mere mechanics of dentistry," may not be something to think about in considering the fundamentals of our profession, but when it comes to operating at the chair, as it appeals or does not appeal to the patients who are seeking our services, it enters very vitally into the success or otherwise of everyone practicing our profession. And while I am thus inferentially arguing for a higher order of manipulative ability on the part of the rank and file, I am going to be encouraging enough, as I have just indicated, to claim that, for the most part, this ability may be acquired by the vast majority of those who are in dental practice, if they will only apply themselves sufficiently to the task. In other words, I have the feeling that the qualifications for successfully practicing dentistry are largely those that may be acquired rather than those that are essentially God-given, and while I still acknowledge that there is a great variation in the native ability of different individuals, and while the old adage of the silk purse and the sow's ear still holds good, I am inclined to contend that the

silkiness of the purse may be greatly increased by the proper refining process of individual effort. It is for this reason that I am so largely in favor of postgraduate study classes, where the manifest limitations of everyday practice may be remedied and the general efficiency of the profession so materially raised.

Yet there is another consideration in this connection. We all know men who have succeeded, at least up to a certain point, without the saving grace of unusual mechanical skill. They succeed through the overpowering and compelling force of an out-of-the-ordinary personality. It is true that they are never so fully entrenched in public or professional esteem as they would be with the proper technical equipment, but their attractiveness personally is such that they manage to "get by" without the fundamentals of real worth and ability. We all know men of this type, but they seldom prove permanently successful nor do they build for themselves a stable economic structure. The ability to gain and hold patients year after year through succeeding generations must come only as the result of a certain amount of skill in addition to personality.

THE PRESENT ECONOMIC STRESS

Let us now consider for a moment what is doubtless in the minds of most of those who are thinking of our present economic situation. We are confronted with the fact that there are large numbers of our citizens who are in need of dental care, but who have not the financial resources with which to recompense the dentist. Does this statement have a strange sound? Have we never heard of it before? How long has it not been the burden of our song? I can say with some assurance that it has been a problem with the profession ever since I can remember, particularly in thickly settled communities, where economic stresses of all kinds are prevalent. The fact that the situation seems more acute today than ever before is due merely to two things: the existence of an unusual economic tension in all of the enterprises of our lives, and another circumstance that is so seldom recognized in any discussion of this question, the fact that the demand for dental service is growing by leaps and bounds regardless of economic or any other considerations. Dentistry has almost suddenly assumed an importance in the public mind, particularly with the class of people most in need of its services and the least able to pay for them, that never obtained till recent times.

The reasons for this are many and manifest. Dental disease is more rampant than ever before where no attention is given the teeth, and there is a constantly increasing recognition of the evils of dental neglect among the people generally. Welfare groups of all kinds are clamoring for help to stem the tide of dental ills, and, with the most laudable impulses of human nature, but with the usual impracticability of certain of these same impulses, are demanding that dentists do something about it. The members of the medical profession, almost for the first time in the nearly a century of our existence, are emphasizing the significance of the mouth and teeth as agencies of harm, and while many of them have sadly lost their balance in estimating the actual rôle played by dental disease in the physical economy, almost every physician today is talking about the teeth and keeping up the interest of the people on this subject. The public as a whole are becoming more and more interested in the teeth, with the result that the demand

for dental service is more apparent than ever before, and there is little wonder that it cannot be met without some adjustment. Just what this adjustment is to be, no one at the moment can predict, but with certain of the plans suggested in the present emergency I am not in the least sympathetic.

I shall refer to this more specifically a little later, but for the present what would seem most profitable is to make some suggestions as to what can be done, or rather, shall we say, what cannot be done. First, we cannot dispense dental service to every worthy individual who needs it without some kind of compensation. To attempt this would be as impossible as it would be harmful. We are confronted with a condition and not a theory, and however much we may theorize, it shall profit us little without facing the facts as they are. And the facts unfortunately are that, constituted as humanity is, there are many of our citizens who cannot receive the dental service that you and I think they should have. This is not only because it is not in the province of the profession to administer this service without some kind of compensation, but because there are very many of the people who have not the reciprocal attitude to receive it and profit by it. Supposing it were possible to put the teeth of the entire populace in excellent condition, and that this happy consummation were a demonstrated fact, how many of our citizens would cooperate with the profession sufficiently to take the proper care of the teeth subsequently? In other words, to how great a degree would a large element of our people reciprocate the attitude of the profession in any laudable effort to ameliorate their dental ills?

It is true that just now we are quite generally concerned with the fact that there are many of our worthy citizens who really desire our help but have not the wherewithal to reimburse the profession for their services. This is a condition that is most unfortunate and even distressing, but we might as well face the fact at once that there is no known means whereby the problem may be instantly solved in its entirety and to the satisfaction of everyone concerned, which means to the satisfaction of welfare workers, the profession, needy patients and society at large. Let it be recognized in the beginning that there is no panacea for the dental ills of the populace short of a great deal of patient and persistent effort and the exercise of almost unlimited self-sacrifice and the broadest possible vision.

It is now quite generally conceded that the problem cannot be solved adequately or completely by the establishment of clinics, either pay clinics or free. There is no question of the good that has been done and that may still be done by certain of these clinics established by philanthropists and there is nothing but praise for the excellent efforts that have made been made in this direction. But this is not the solution of the needs of the hour that are everywhere manifest.

The nearest approach to the situation, it seems to me is for each dentist to accept in a whole-hearted and generous way the responsibility of receiving as patients in his own office those who are in need, on a basis of renumeration that is as nearly equitable as human ingenuity can arrange it. It is not contended that through this agency the entire problem can be met, nor do I think that any plan yet suggested will work out 100 per cent to the satisfaction of all, but it at least will serve to demonstrate the fact that the members of our profession stand willing to serve our citizens to the best of their

ability, and with a keen recognition of the needs of the poor and dependent.

I have nothing but admiration for the various plans that have been suggested for meeting the situation in our present economic dilemma through the medium of a tie-up between various lay groups and the dental profession in the form of mouth hygiene associations, whereby the two combine for the common good. Anything that will enlist the cooperation of the profession and the public in an effort to bring about dental relief has my hearty encouragement, but, as I view it, before we can work out a practical plan of this kind, the expenditure of much time and effort and the development of infinite routine will be required, calling for a most unusual demonstration on the part of the entity commonly known as human nature.

Of only one plan that has been prominently recommended do I stand in direct opposition. The suggestion that we attempt to solve the problem under the agency of state control, or state direction, or state aid through the medium of taxation, I am irrevocably and unalterably opposed to. I have spoken and written on this subject sufficiently to absolve myself of the necessity for trespassing further on your time on this occasion, but I should merely like once more to go on record as declaring my earnest conviction that there has never been suggested in our profession any plan more pernicious than this, or more subversive of the best interests of everyone, not only of the profession but particularly of the citizens of our commonwealth.

THE QUESTION OF FEES

Inevitably interwoven with the question of economics is the problem of fees. This problem has been present ever since the earliest practice of dentistry, and probably it will be more or less of a problem to the end of the chapter. Adequate compensation for our services with an equitable adjustment of the point of view between patient and practitioner has always entered into the picture whenever an individual takes a dental chair, and much consideration has been given the subject by our dental economists from time to time.

First, we must acknowledge that a dentist is entitled to a just fee when he delivers service to a patient. The exactions in the way of physical and nervous tension involved in everyday dental practice are such that unless the operator receives a commensurate reward he is robbing himself and his family of those legitimate emoluments to which every individual is entitled. This is so manifest on its face that it is accepted as a tenet of our economic faith wherever men meet in any discussion of the subject. The great problem is to have the patient as well as the dentist recognize this. It has taken long years of patient endeavor to establish this idea in the minds of the public, and in too many cases it is not yet sufficiently recognized.

But there is another side to the picture. In assuring recognition of the rights of the dentist on the part of the patient, we must have a care that we do not exact an unreasonable fee or exploit the patient in any way. In the not too distant past, we have witnessed a certain tendency on the part of some of our practitioners to exact fees that were so far from being equitable that they have elicited not only ridicule but also resentment on the part of the people. This is always unfortunate. Anything that detracts from the respect that the people hold for dentists or dentistry, or that disturbs in any way the cordial relationship that should obtain between the two parties to a transac-

tion as intimate as this, must be accounted not only unfortunate but also detrimental to the best interests of all concerned, and I cannot escape the conviction that there is one aspect of the prevalent economic *impasse* that has had a very salutary effect on the kind of exploitation just referred to. The simple fact is that recently the people have not had the money to enable them to submit to extravagant fees, and have been obliged to hold their pursestrings so tight that any attempts at excessive charges have merely resulted in a change of dentist. This is one reason that so many men with a reputation for high fees have been made to feel the economic pinch to a probably greater degree than the rank and file of our profession. After all, the ability to look every patient in the face and prove to him in a convincing way that the fees charged are just and reasonable will go a long way toward establishing an *entente cordiale* between patient and practitioner that will not only make for harmony between individuals, but will also develop a sentiment among the people generally that will make the dental pathway much smoother and its thorns and briers fewer.

One thing connected with the question of fees should ever be present in the mind of the dentist. Never should there be the slighest hesitation about rendering a service for the relief of pain, regardless of the patient's ability to pay. The presence of suffering should always be the open sesame to the best endeavors on the part of any dentist to bring about relief whether the patient has a dollar or a penny or nothing at all. The moment a dentist reaches out his hand to receive his diploma, he obligates himself to stop pain without consideration of financial reward. Further transactions after pain has been relieved are another matter.

ADVERTISING

Much has been said about dental advertising, and much more needs to be said. It has many angles. In recent years, an attempt to advertise dentistry to the laity was in certain of its results almost disastrous. This was largely due to misunderstanding of motives and misconception of methods. To go fully into this in the present instance would be futile and out of place, but, in a general way, the statement may be made that any effort to enlighten the people on the needs of dental service, or the means whereby this may be best brought about, is in every way commendable, and should be cordially encouraged. But anything that smacks of dental advertising in the accepted sense of the term should be frowned on by every practicing dentist who has the welfare of the profession or the people at heart.

Let us consider briefly the ethical aspect of advertising in professional life. There is no objection to advertising in the commercial world provided it involves no misrepresentation or false information in respect to the products advertised. The best side of any product may legitimately be presented to the public if the advertiser stays within the limits of fact, but there is a constantly growing sentiment, even among the advertisers of commercial products, that misleading statements are reprehensible and are no longer to be countenanced. In other words, the ethics of advertising is improving.

This naturally brings up the question of the ethics of advertising among professional men. Some of our writers are intimating that there should be essentially no difference between advertising in commerce and in the professions, but

there is a fundamental difference. The advertiser in the business world is emphasizing the virtues of a commodity, which may be perfectly proper, but the professional man who advertises is magnifying the virtues of an individual, and in this there is a vast distinction. A dentist who advertises is essentially announcing to the world that he is better than other dentists, and aside from the essential lack of modesty of such a procedure, there is usually an element of dishonesty connected with it, for the reason that a dentist who feels that he must advertise thereby tacitly acknowledges that he is not so efficient as other dentists, and must therefore seek to gain patronage through the agency of propaganda.

The professional man is all the while dealing with individuals, with people, and the business man is dealing with things or commodities. The obligation is entirely different and the responsibility of the professional man is vastly greater. If the business man is inefficient and makes a mistake, the injury is usually a mere monetary one, but a mistake of the professional man may mar a human life and be irreparable. That is why the obligation of the professional man stands out as transcendent, and why a code of ethics was formulated early in the history of the profession, to govern the conduct of the professional man and place on him exactions of conduct and practice that never obtain in the business world. It was for this reason that advertising in the ordinary business sense was proscribed in the professional code, and it is a noteworthy fact that this embargo has given the professions an established status in the eyes of the world that otherwise it never would have possessed.

The practice of dentistry would have have been a vastly different affair, and we would have achieved much less not only in prestige but also in the material emoluments of life had not our profession been hedged about by ethical restrictions that at once established the fact that we were men and women of standing in society, and that we stood for something beyond the mere considerations of barter and trade. The world generally respects dentistry, and it is only because we had an ethical code and have endeavored to live up to it. Let those on whom the code seems to bear heavily, and who at times are led to chafe under its restrictions, be heartened by the thought that it is only by virtue of the code and its observance that every dentist has the status of a professional man, with all of the privileges and prestige pertaining thereto.

Sometimes, the question is seriously raised as to the possibility of enacting laws that will prohibit advertising by a professional man. Ethical dentists are generally a unit in condemning advertising in professional life, yet it is not so easy to limit advertising by law. It requires a great deal of education to convince our law-making bodies that advertising is sufficiently reprehensible to make it a matter for legal restrictions, though I am told that a law of this character has been passed in certain communities. I feel that before this can be consummated generally, much education on the part of the public will be required, yet I am convinced that we should lose no opportunity to register our conviction as to the essential injury that is usually done by this kind of advertising, and I cannot but feel that the lay public of the better class is gradually awakening to the impropriety of this practice, with the ultimate possible aim of a legal prohibition. Yet I must say that what really concerns us most is the kind of service given to the people, whether by advertisers or others. That

man is of the greatest value to the community who uniformly renders the most acceptable service to the people regardless of whether he advertises or not; but of course we all know that the vast majority of advertising dentists give discreditable service.

PROVISION FOR THE FUTURE

As I have observed the careers of many of the members of our profession, I have been impressed with the appalling negligence frequently displayed by dentists of otherwise more than average intelligence when it comes to making provision for declining years, ill health or other exigencies. In the heyday of our lives there is usually ample opportunity to so conserve our resources that we can not only maintain our families in a respectable and comfortable environment, but also, barring unusual or unforeseen reverses, we can put aside sufficient in the way of investment to provide for all of the emergencies of our latter years, and not be a burden on relatives or on society at large. The utter lack of responsibility or obligation in this matter has seemed inexplicable to me as I have observed so many men in our profession who have been blessed with at least the average amount of acumen and opportunity in the ordinary affairs of life, but who have made a sad wreck of their business management in the way of lack of provision for the future.

It is no justification for indifference in this regard to cite the experiences of many men in the recent past, when the best laid plans of careful and intelligent men have come to grief through the prevalent economic debacle that has swept away so many fortunes and left havoc in their wake. The experience of the past few years has been no index of the ordinary affairs of our lives, and therefore has provided no example for our future policies. An acute depression such as that from which we have just suffered should only be the greater reason for an intelligent study of our economic needs, and surely for a realization that the only safety of the individual is to make provision for the future. Many of our dentists have doubtless lost much of their material resources in the way of investments, and for this there can be nothing but sympathy and regret, but if these losses are going to lead to despair and indifference, it is only because there is something essentially wrong with the mental fiber of the individual. I have faith that the members of our profession are made of better caliber than this, and I look for an economic regeneration in our ranks that shall hearten us and make our future more secure than it has ever been in the past. I am not at all sure that our recent experiences, sad and bitter as some of them undoubtedly have been, may not in the end prove to be of the greatest benefit to all of us.

OUR HERITAGE

I seldom am led to contemplate the future of dentistry, professionally or economically, without more or less of a thrill as to its possibilities. In my lifetime, I have seen our profession develop, in an unbelievable way. I have seen it emerge from a status where a few outstanding men of real ability constituted the most there was of true professional idealism in our calling, where the rank and file of our members had only the vaguest conception of the real ethics of professional life, and where the hall marks of a trade were only too apparent in our midst. It was the exception rather than the rule for dentists in those days to be economically affluent, and the

compensation for dental service was in the main inadequate.

It has been my cherished privilege to live to see dentistry honored as one of the leading professions of the day, with a status side by side with the most learned of them all, and respected as a medium of serving humanity second only to that of the three great professions of the ancient and modern world. I have seen dentists advanced economically so that most of them own their homes—homes of a character to command the respect and admiration of the communities in which they live. I have seen the social status of dentists advanced till there is no longer any reflection or limitation implied in the appellation of dentist, and I have seen them take their place in the community councils where men meet men on a common footing and with common ideals and ambitions.

And seeing all of this as a concrete evolution of what I have witnessed in the past, I cannot but have an optimistic attitude as to the future, and I have the hope that our fondest ambitions will in the fullness of time be realized. With the heritage that has come down to us as an earnest of what we have accomplished in the days gone by, we can confidently go forward to even greater achievements in the fruitful days to come, where the blessings of our profession shall be brought to the highways and byways of this fair land of ours, and shed their beneficence among the sons and daughters of men.

ESTHETIC PROBLEMS IN ANTERIOR RESTORATIONS: WHAT SHALL GOVERN THE CHOICE OF A FILLING MATERIAL*

By R. W. RULE, D.D.S., San Francisco, Calif.

THE advance in knowledge brought to us during the past few years through research in biochemistry and mineral metabolism has given us an excellent foundation on which to build for prevention. The possibility of control of dental caries through metabolic processes has been demonstrated. The number of people who are willing to listen and to profit by dietary instruction has greatly increased. The prediction is made that, within a very few years, the progressive members of our profession will be able to give such instruction to mothers as will enable them to bring forth and rear children who will have sound teeth in healthy bodies. This is not to set aside or to controvert the importance of local hygienic care as a preventive measure. That also is important and doubtless will always remain desirable if not entirely essential. Preventive dentistry has come to stay.

Nevertheless, we will always have restorative work to do. Many people will not receive instruction in time to prevent

* Read before the Section on Operative Dentistry at the annual meeting of the California State Dental Association, April 23, 1933.

disease. Many others will not exercise the self control which will be necessary to obtain results.

This being the case, we shall be called on continually to make a choice between the filling materials available for any given case. In this paper, only the anterior teeth will be considered. At the present time, we may choose between the silicate cements, gold foil, and gold or porcelain inlays.

SILICATE CEMENT

Silicate cement has been greatly abused. The average life of silicate fillings has been said to be probably less than two years.[1] That this estimate may be correct is based on (1) the use of the material where it is contraindicated and (2) the slipshod methods sometimes employed in its use and manipulation. It has its desirable qualities and its weak points; its indications and its contraindications. It should never be used unless the operator is willing to learn and follow closely the technic necessary to obtain the best results possible, and then only when the contraindications are not such as to preclude the probability of a fair length of service. Were these principles followed generally by all operators, the average life of silicate fillings would be much closer to ten or twelve years. Many operators can present such a record from their practices. The chief advantage of silicate cement as a filling material is its esthetic possibilities when it is used in carefully selected cases.

Its chief disadvantages are its inherent weakness, its shrinkage, the difficulty of carrying through in every case a technic which will give the best results and the ease with which it lends itself to abuse. To this may be added the fact that the gingival tissues do not take kindly to the margins of silicate cement fillings. Ordinarily, silicate cement is contraindicated if the contact point is involved, and always so on the distal surface of the cuspid. There is no more important place for a hard, tight, well-formed contact than the distal surface of the cuspid teeth, and such conditions cannot be secured and maintained with silicate cement.

If an attempt is made to restore contact points of the incisal teeth with silicate cements, separation should be obtained and held until the cement has had sufficient time to set so that it will not change form when the teeth are released. The cement should be mixed quickly to a consistency as thick as will permit of proper manipulation in the cavity and, when fully set, trimmed carefully to form, with a well-rounded, and not a flat, contact area. Fillings made under these conditions will maintain a fair contact for a reasonable period of time, provided stress and mobility are not too great; but they will not compare in service with a metal restoration.

Failing silicate fillings involving contact areas and approaching incisal angles are responsible for many difficult problems which would not have arisen if the proper material had been used before it was too late. Too great importance cannot be attached to this statement. The situation is serious; so serious that the promiscuous use of silicate cements has become a positive menace. One of the cases most frequently seen in the dental office today is that of incisor teeth so mutilated in this way that the only means of restoring them is the unsightly mesio-incisodistal inlay or three-quarter veneer metal or porcelain veneer crown. In most of these cases, had the original

1. Black, A.D.: Progress in Operative Dentistry in Recent Years, J. A. D. A., 15: 1194 (July) 1928.

filling been of gold foil, the outlines could have been so made that the fillings would have been quite inconspicuous, and their durability much longer, extending even to the life of the tooth.

The silicate filling is of real value on the mesial surface of the upper central incisors. The mesio-incisal angles of these teeth are usually sharp and rather square, and the mesial surfaces relatively flat incisogingivally, the contacts coming just at or very close to the angle. Not infrequently, the conditions here are such that the contact cannot be restored in metal without involving the angle; which would be a great misfortune. It is true that, in some cases, by separating the teeth a little and rounding out the contour of the filling, the contact may be re-formed somewhat gingivally from the original spot. This is not always practical. Moreover, this area is the most conspicuous in the mouth, except hypoplastic spots on the labial surfaces or incisal edges. In these places, if the cavity is detected early enough, the teeth may be separated slightly, the cavity prepared with very little extension and a silicate filling placed, which, if the work is well done, would give excellent service.

PORCELAIN INLAYS

Porcelain inlays have a limited but important field. To secure good results with these inlays is the most difficult work that we have to do in filling teeth. Comparatively few have the necessary skill, training and experience combined, to do the work with any great degree of success. It is within the reach of operators who will take the trouble to perfect themselves in the art and technic.

Its major indications are those cases in which the esthetic demands are such as to prohibit the use of stronger materials in large Class III cases, certain Class IV cases, when strength and stress conditions permit, and Class V cases.

GOLD RESTORATIONS

May we consider gold inlay and gold foil restorations, first, from the standpoint of their relative value and practicability, and, second, as to the objections to gold from an esthetic standpoint, referring particularly to Class III operations, i. e., those occurring on the proximal surfaces of incisors and cuspids, but not involving the incisal angle, and Class V or gingival third cavities on the labial surfaces.

Regardless of any controversy as to the choice between these two materials in other parts of the mouth, gold foil seems to possess certain definite advantages over the inlay in these positions. The general advantages of gold foil over other materials have been enumerated elsewhere,[2] but some applying specifically to this discussion should be mentioned. 1. Gold foil can be placed with a minimum cutting of tooth structure and a minimum use of the separator. 2. The operation can be completed at one sitting of reasonably short duration, and in less gross or net time than the inlay. 3. It can be perfectly adapted to the cavity walls and margins, its use thus eliminating the cement line and leaving a margin which will remain free from leakage, in perfect continuity with the tooth surfaces and in most favorable relation to the gingival tissues.

The inlay cannot be made for Class III cavities without sacrificing considerably more tooth structure than is necessary for gold foil fillings. It calls for an entirely different cavity preparation in order to permit the pattern to be withdrawn, a preparation which is more dif-

2. Rule, R. W.: Gold Foil: Simple Time Saving Method, Not Requiring Unusual Skill, J.A.D.A., 17:1048 (June) 1930.

ficult and which does not meet the ideals of retention and extension for immunity so well. In fact, it is feared that the silicate cements are so often used not alone because of the legitimate desire for a material of better color, but also because of the relative ease with which a temporarily good result may be obtained, as compared to the difficulty of making good Class III inlays, and the fact that most of the present generation of dentists have either forgotten or else never knew how to handle gold foil. He who is looking for easy methods is usually satisfied with inferior results.

OBJECTION TO GOLD FROM AN ESTHETIC STANDPOINT

A great many operators have considered gold foil difficult to manipulate. The principle reasons for this are that the operator either has failed, perhaps through faulty teaching, to grasp the comparatively simple underlying principles of its successful management, or has not expended the time and energy necessary to master the technic involved. There always has been a valid objection to its use in the anterior teeth, because of its color.

Long ago, the desirable qualities of a filling material of both primary and secondary importance were specified by Black. Of these, color or appearance was listed among those of secondary importance, although perhaps in a few cases it might be classed as of primary importance. Unfortunately, the efforts made to produce a material which would possess all of these desirable qualities in high degree, including good color, have been in vain.

In view of the limitations of porcelain and the difficulties of obtaining the best results with it, and the unquestioned deficiencies of the silicate cements, it is felt that gold foil is the material distinctly indicated in a large percentage of Class III and Class V operations. On the other hand, the closest attention should be given to details that are a factor in making its appearance the least objectionable.

Black[3] called attention to harmony of cavity outline and perfect tooth form in that part which was being restored. These two crucial points constitute the difference between success and failure in the eyes of the esthetically minded patient. I fully agree with Black as to the question of perfect tooth form, but I find it necessary to take a partial exception to his statement that "slightly curved lines are better from the esthetic standpoint than straight lines."[4]

There is a principle involved here which needs to be considered. It is that in cavity outlines where materials are to be used which differ in color from the tooth, those lines which most nearly conform to the structural lines of the tooth are the least conspicuous and the most pleasing to the eye. This applies both to the cavity outline, which determines the inner surface marking or margin of the filling, and to the outer portion or contour of the filling, which is determined by the contour of the tooth.

This question, as far as it relates to the straight labial outline of a Class III cavity or filling, was brought to my attention many years ago by the late A. C. Searle. I am not aware that anything has ever been published concerning it, saving brief references to it in some of my papers. Hence, I desire at this time to set it forth as a principle of great importance from the esthetic standpoint in restorative work in the anterior teeth and to elaborate it more fully.

3. Black, G. V.: Operative Dentistry, Ed. 6, Chicago: Medical-Dental Publishing Co., pp. 190 and 287.

4. Footnote 3, p. 190.

In a Class III cavity, we must consider the labial outline and the manner in which it is joined to the gingival and incisal outlines. Two factors are important, its position and its character or form. Naturally, it is very desirable not to have it extend too far onto the labial surface. On the other hand, attention has been called to the fact that stopping far short of the mesiolabial or distolabial angle is likely to make the filling appear as a cavity rather than a filling. It would seem that the most ideal position is in the axial direction, in a labiolingual plane which, in passing through the crown of the tooth, would touch the dentino-enamel line in the center of the proximal surface. (Figs. 1-2.) If the tooth is in normal alinement, this will not be too great an extension. On the other hand, if caries has undermined the labial enamel, thus forcing greater extension, it is merely unfortunate. A compromise may then be made which will be described later.

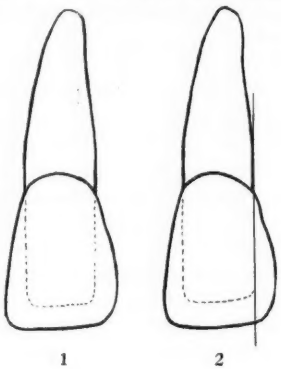

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Fig. 1.—Diagram of upper left central incisor. The dotted line shows the outline of the dentin.

Fig. 2.—Diagram of incisor with straight line showing position of plane bisecting tooth labiolingually at dentino-enamel junction in center of proximal surface.

Assuming that we may keep the ideal position, the form should be, in appearance, that of a straight line as viewed from the front as one would face the patient in conversation. Of course, there cannot, strictly speaking, be a straight line on a rounding surface any more than a circumference may be a straight line, but such a line will appear straight when viewed in the sagittal plane. As this so-called "straight line" approaches the gingival area, it should round over onto the proximal surface (Fig. 3 *a*) to join the gingival portion of the outline with a rather short curve, sufficient to avoid the appearance of a sharp angle on the enamel surface. Its direction should be as nearly parallel as possible, not to the proximal contour of the tooth, but to the developmental grooves which lie in the long axis of the tooth. (Fig. 3 *c*.) This is important from the standpoint of the esthetic principle referred to above.

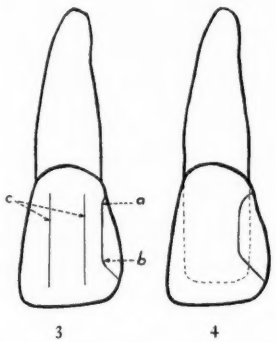

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Fig. 3.—Main portion of labial outline shown straight and parallel to developmental grooves. *a*, labiogingival curve; *b*, labioincisal curve; *c*, straight lines representing direction and position of developmental grooves.

Fig. 4.—More extensive involvement showing shorter straight portion of labial outline and longer labiogingival curve.

As the outline approaches the incisal edge, it should again round over toward the proximal aspect to meet the incisal slope in a rounded angle. (Fig. 3 *b*.) In case of being forced to make greater labial extension, the compromise above referred to involves reducing the length of the straight portion of the labial outline and rounding off sooner toward the proximal surface with somewhat longer curves to meet the gingival and proximal outlines, as in Figure 4. The inclination of the incisal slope should be approximately 45 or 50 degrees to the horizontal plane of the tooth. The incisal slope is the one portion of this Class III outline which does not lend itself to conformity with the structural lines of the tooth. It should not be a continuous curve, but a short straight slope joined by a graceful curve to the labial line. The inclination suggested seems to give the best appearance.

The gingival outline should follow or parallel the curvature of the gingival line and be kept about 1 mm. away from it when conditions permit. (Fig. 5.)

In addition to its esthetic value, other advantages of the straight labial line parallel to the developmental grooves are that it brings the labiogingival angle into a comparatively immune area, and gives better access for condensing the foil in the incisal angle. For these reasons, the same general outline should be carried out on the lingual surface. (Fig. 6.) This also gives the best possible conditions as to the plane of the enamel walls in relationship to the direction of the enamel rods, which changes rapidly in this position.

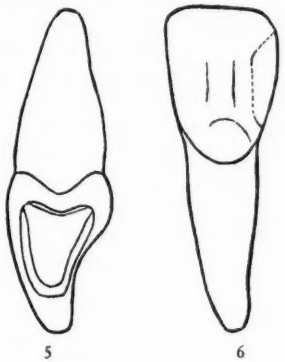

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Fig. 5.—Proximal view showing gingival portion of cavity outline parallel to gingival line on proximal portion of tooth.

Fig. 6.—Lingual view of tooth. Dotted lines show the same principles of cavity outline carried out on the lingual as on the labial surface.

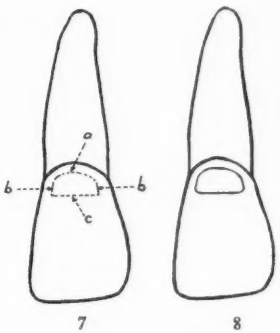

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Fig. 7.—Labial view showing outline of Class V or gingival third cavities. *a*, gingival portion of outline parallel to gingival line of tooth; *b-b*, proximal portions of tooth; *c*, straight incisal outline in horizontal plane of tooth.

Fig. 8.—Finished Class V outline showing lines of Figure 7 joined with curves.

GINGIVAL THIRD CAVITIES

Conformity to the structural lines of the tooth for Class V cavities is carried out as follows: 1. The gingival outline is made parallel to and, where practical, just beneath the gingival border of the soft tissues. (Fig. 7 *a*.) 2. The mesial and distal lines are made just short of

the mesiolabial and distolabial angles of the tooth, parallel to the proximal contour of the tooth in these areas when viewed in the sagittal plane. (Fig. 7 *b*.) 3. The incisal or occlusal outline is made parallel to the horizontal plane of the tooth. It should be straight in the major portion of its length when viewed in the horizontal plane and only carried so far incisally as will bring it into an area of comparative immunity. (Fig. 7 *c*.) 4. All of these lines should be joined with curves. (Fig. 8.) A sharp angle should never appear on the surface of the enamel within the range of vision.

The mesial and distal lines will virtually be continuous curves joining the gingival and incisal lines, although where the gingivo-incisal width of the cavity is considerable, the central portion of the mesial and distal lines should be approximately straight. (Fig. 7 *b*.)

In most cases of this type, the gingival border has receded somewhat, and it is, in many cases, surprising how nicely the gums will creep down over a perfectly smooth gold foil margin, almost or entirely covering a narrow filling. When the cavity is necessarily wide or the lip raises high in smiling or speaking, it is often well to use porcelain inlays. The silicate cement is not a favorable material for these cavities, as the gum tissues tend to recede from it instead of coming down over it as they do with gold foil.

OVERCOMING THE OBJECTIONS OF THE PATIENT

When gold is advocated for the anterior teeth, the criticism most often made is that the patient will not "stand for it." Assuming that this is the real reason of any given operator for refraining from its use, and, in some cases at least, it is a valid one, let us consider why patients object to it and what may be done to overcome their objections.

Doubtless the principal reason is that unsightly fillings, which inevitably attract unfavorable attention, are common. The unsightliness is due to (1) neglect of the teeth until they are broken down so badly that they cannot be restored without showing much gold, (2) the use of the old crescent-shaped labial outline so commonly seen, (3) failure to trim the filling to good tooth form and give it a perfectly even, smooth surface, and (4) a combination of the two latter points, which is very commonly found.

The patient may have seen these unsightly fillings in the mouths of their friends, or they may have them in their own mouths. Many times, the consent of patients has been won to the use of gold in the anterior teeth merely by trimming to form and polishing one or more fillings which they already have, thus so improving their appearance as to remove the principal objection, and explaining that if the cavity outline had been properly made, the filling would have been still less conspicuous.

A very effective demonstration consists in having a "typodont" with an ideal restoration in, say, the distal surface of an upper right central incisor and a corresponding one in the distal surface of the upper left central incisor in which the cavity has been prepared with a rounded labial outline of the type so frequently seen, and still another in an adjoining lateral incisor or the cuspid with a bulging contour which has not been trimmed to form or well finished.

Again, one is frequently able to point out in the mouth of the patient silicate fillings of comparatively recent placement which are more unsightly than gold foil would need to be. The silicate filling which is off color, or is stained or broken down around the margin, becoming discolored, is not a thing of beauty.

After all, the question of durability is the strongest point to be made. Certain patients will place appearance above durability, but a great many will not, and especially so when it is explained that, with each replacement of silicate cement, the filling becomes larger and that, before long, a condition arises in which there is no choice save a necessarily unsightly metallic filling or a porcelain veneer crown.

On the other hand, having promised the patient a filling which will not be too conspicuous or unsightly, and that will give a long service, it is incumbent on the operator to measure up to this standard, even to beyond his promises. His technic should be perfected in those cases in which the patient has not been led to expect too much until he is sure of his ground. Tact and deftness, too, should be learned, and exercised, in handling the patient gently and the work expeditiously, that the patient may not become wearied by the tediousness of the operation. How many times has the remark been heard at the end of the operation, when a mirror has been handed the patient: "Why that is not bad at all; it doesn't show nearly so much as I expected it would."

Not all cases can be handled entirely satisfactorily from an esthetic standpoint. Where caries or silicate operations have undermined the labial enamel, and extensive cutting labially becomes necessary, gold, if used, will be more conspicuous and more objectionable and doubtless should not be urged against the patient's wishes. Under these circumstances, the choice may well be left to the patient, with a full understanding of the probable outcome with the use of each of the different materials which may be available. If the gold foil operation is chosen, it should be made as nearly perfect a piece of work as possible, from both the esthetic and the constructive standpoint. Indeed, let the dentist take a pride in his work and strive to make every operation a work of art, not forgetting the old saying that "True art is to conceal your art."

OBSERVATIONS ON DIET IN ITS RELATION TO DENTAL DISEASE

By JOSEPH LENNOX, D.D.S., Cape Town, South Africa

A FEW years ago, in several articles,[1] I enunciated the phosphorus deficiency theory of the causation of dental caries, a theory based on estimates made after a careful investigation of the diets of certain aboriginal tribes of South West Africa, and of diets reported by other investigators as being eaten by uncivilized peoples who are relatively free from dental caries. The conclusion arrived at was that our civilized diets are caries-producing because they are so denatured by civilized methods of preparation as to become deficient in phosphorus. Our bodies, therefore, became phosphorus

1. Lennox, Joseph: Observations on Diet in Its Relation to Dental Disease, South African D. J., March, 1929; July, August, September, 1930; March, May, 1931.

deficient; and in an effort to remedy this deficiency, some change took place in the saliva which appeared to remove its natural inhibitory action on the activities of the lactobacilli, and thus by carbohydrate fermentation, lactic acid formation, phosphorus was leached from the crowns of teeth. Since laboratory experiments by other investigators on animals appear to substantiate my hypothesis, and since I have succeeded in preventing dental caries in my own practice solely by phosphorus therapy, an attempt is now made to place my views as a comprehensive whole before the profession.

Out of all the wealth of literature on the subject of the causation of dental caries, one important fact stands forth most prominently, i. e., that a pure natural diet, one free from civilized interference, does not appear to predispose to dental caries. Bunting[2] has shown that a diet relatively free from sugar retards the progress of caries more effectively than modern prophylactic measures. Waugh[3] has reported that Eskimos living on natural foods have practically no caries. Moore and Sampson[4] examined the mouths of the white inhabitants of the island of Tristan da Cunha, who are unable to obtain anything but natural foods, and found that they are relatively free from dental caries. I examined the mouths of thousands of African natives living on natural diets and failed to find

TABLE 1.—SIMPLE DIET NO. 1 (PURIFIED)

	Ounces	Calories	Calcium Gm.	Phosphorus Gm.
White flour	12	1,200	0.072	0.312
Sugar	5	575	.....	.....
Butter	3	654	0.020	0.015
Beef	6	360	0.024	0.390
Potatoes	6	150	0.024	0.196
Cheese	1	125	0.264	0.194
Cornmeal	6	604	0.030	0.324
Total	39	3,668	0.434	1.431

TABLE 2.—SIMPLE DIET NO. 1 (UNPURIFIED)

	Ounces	Calories	Calcium Gm.	Phosphorus Gm.
Wholewheat flour	12	1,224	0.108	0.804
Butter	3	654	0.020	0.015
Beef	12	720	0.048	0.780
Potatoes	14	350	0.056	0.224
Cheese	1	125	0.264	0.194
Cornmeal	6	604	0.030	0.324
Total	48	3,677	0.526	2.341

2. Bunting, R. W.: Proc. Soc. Exper. Biol. & Med., 27:426-427, 1929; D. Cosmos, 72:399-407 (April) 1930.

3. Waugh, L. M.: J. D. Res., 8:428 (June) 1928; 10:387 (June) 1930; 11:453 (June) 1931.

4. Moore and Sampson: South African D. J., June, 1932, p. 181.

any caries. The Bushman, living chiefly on meat, the Herero, living almost entirely on soured milk, and the Ovambo, living chiefly on millet seed and milk, all have teeth free from caries.

Since a meat diet is acid in its end products of metabolism, and a milk diet alkaline, we can only conclude that the acidity or alkalinity of a diet does not appear to play a part in inducing caries. It would also appear that diets that are free from refined foods such as sugar and white flour, and all the products made from them, such as pastries, cakes, jams and candies, are noncaries-producing.

It is generally accepted that the incidence of dental caries has been rapidly increasing during the last hundred years, and, coincidently, our diets have undergone remarkable changes. These changes have been caused by the introduction of efficient roller milling processes and the cheapening of refined sugar, which has consequently become a common article of everyday diet. These changes have caused our diets to become entirely altered with regard to mineral content, and an attempt is here made to show how that has happened.

The average consumption of sugar in the United States per person is 120

TABLE 3.—DIET NO. 2 (PURIFIED)

	Ounces	Calories	Calcium Gm.	Phosphorus Gm.
White flour	12	1,200	0.072	0.312
Sugar	5	575	.....	.....
Meat	6	360	0.024	0.390
Cabbage	2	18	0.026	0.016
Carrots	2	25	0.032	0.026
Potatoes	4	94	0.016	0.064
Milk	8	160	0.282	0.208
Oranges	4	58	0.052	0.024
Eggs (2)	3	126	0.057	0.153
Butter	2	436	0.008	0.010
Total	48	3,052	0.569	1.203

TABLE 4.—DIET NO. 2 (UNPURIFIED)

	Ounces	Calories	Calcium Gm.	Phosphorus Gm.
Wholewheat	12	1,224	0.108	0.804
Meat	8	480	0.032	0.520
Cabbage	4	36	0.052	0.032
Carrots	4	50	0.064	0.052
Potatoes	8	188	0.032	0.128
Milk	11½	226	0.391	0.299
Butter	2½	545	0.010	0.020
Oranges	8	116	0.104	0.048
Eggs (3)	4½	189	0.086	0.229
Total	62½	3,054	0.879	2.132

pounds a year. This is roughly 5 ounces a day, equivalent to 567 calories of a purified carbohydrate which is entirely free from calcium and phosphorus, two minerals which are required by the body for its well being in relatively large quantities. The estimated amount of white flour consumed each day in the form of bread, cakes, pastries, puddings, thickening for soups and gravies, etc., is 12 ounces per capita. By the removal of the husk and germ of wheat, modern roller mills remove 61 per cent of the phosphorus content of the flour and 35 per cent of the calcium. In compiling daily diets to show the effects of white flour and sugar, it is deemed fair to include 5 ounces of sugar and 12 ounces of white bread in each example. (Table 1.)

TABLE 5. — DIET NO. 3 (PURIFIED)

	Ounces	Calories	Calcium Gm.	Phosphorus Gm.
Breakfast				
Eggs (1)	1½	63	0.028	0.071
Rolled oats	2	225	0.040	0.222
White bread	4	280	0.032	0.094
Sugar	2	224	.....	.....
Butter	½	109	0.002	0.010
Total	10	901	0.102	0.397
Lunch				
Fish	4	93	0.024	0.244
Potatoes	8	109	0.032	0.198
Lettuce	2	10	0.024	0.024
Tomatoes	4	26	0.012	0.028
White bread	4	280	0.032	0.094
Butter	½	109	0.002	0.010
Sugar	3	336	.....	.....
Apples	4	71	0.008	0.012
Total	29½	1,034	0.134	0.540
Dinner				
Meat	4	240	0.016	0.260
Potatoes	4	54	0.016	0.064
Peas	2	56	0.016	0.072
Carrots	2	25	0.032	0.026
White bread	4	280	0.032	0.094
Butter	½	109	0.002	0.010
Sugar	3	336	.....	.....
Milk (per diem)	8	157	0.272	0.211
Grapefruit	8	107	0.047	0.045
Total	35½	1,364	0.441	0.794
Total (per diem)	75	3,299	0.677	1.731

Articles of diet generally regarded as being rich in phosphorus, such as beef, potatoes, cheese and cornmeal, are included in liberal amounts. Nevertheless,

it will be shown to be deficient in both calcium and phosphorus. To show how purification, or the inclusion of sugar and white flour, has affected the diet, in the next example (Table 2) we will remove those two substances, substituting wholewheat bread for the white bread and dividing the sugar calories among the other foods. This is done because, if the sugar calories were not consumed, more of the other foods would have to be eaten to satisfy the appetite.

Table 6. — Diet No. 3 (Unpurified)

	Ounces	Calories	Calcium Gm.	Phosphorus Gm.
Breakfast				
Eggs (2)	3	126	0.056	0.142
Rolled oats	4	450	0.080	0.444
Brown bread	4	280	0.024	0.172
Butter	½	109	0.002	0.010
Total	11½	965	0.162	0.768
Lunch				
Fish	8	185	0.048	0.488
Potatoes	8	109	0.032	0.128
Lettuce	4	20	0.048	0.048
Tomatoes	8	52	0.024	0.056
Brown bread	8	560	0.048	0.344
Butter	½	109	0.002	0.010
Apples	4	71	0.008	0.012
Total	40½	1,107	0.210	1.086
Dinner				
Meat	6	360	0.024	0.390
Potatoes	6	80	0.024	0.096
Peas	4	112	0.032	0.144
Carrots	4	50	0.064	0.056
Brown bread	4	280	0.024	0.172
Butter	½	109	0.002	0.010
Milk (per diem)	8	157	0.272	0.211
Grapefruit	10	120	0.060	0.056
Total	42½	1,258	0.502	1.135
Total (per diem)	94½	3,330	0.874	2.989

Although the caloric values of the two diets are more or less equal, and although they are composed of the same foods, except for white flour and sugar, their mineral content is entirely different. It will be seen that the elimination of 5 ounces of sugar and the use of white instead of brown flour have been responsible for depriving the body of about 0.1 gm. of calcium, and almost 1 gm. of phosphorus. The phosphorus intake changes from a probable deficiency to a certain sufficiency. Apparently, the calcium is also deficient, but that will be dealt with later. A diet with more va-

riety will now be used as an example. (Table 3.)

In terms of unpurified food products, and distributing the sugar calories among the other foods, we get Diet No. 2, unpurified. (Table 4.)

In this instance, the calcium appears to have become sufficient, but attention is invited to the enormous difference in the phosphorus content of the two diets. Although the caloric intake remains the same, the phosphorus content is nearly doubled. As a final example, an even larger choice of foods is given. (Table 5.) One can call it an exceptional diet, as few people would eat such a diet daily. Again withdrawing sugar, and substituting brown for white bread, we get the diet given in Table 6.

Again the phosphorus content has been increased enormously. It becomes apparent that sugar is not only an appetite destroyer for phosphorus-bearing foods, but is also thereby a mineral thief. It is also evident that this affects phosphorus enormously, while calcium is affected only slightly in comparison. Tabulation of the three diets is given in Table 7.

TABLE 7.—CONTENT OF DIETS

	Calories	Calcium Gm.	Phosphorus Gm.
Diet No. 1			
Purified	3,668	0.434	1.431
Unpurified	3,677	0.526	2.341
Diet No. 2			
Purified	3,052	0.569	1.203
Unpurified	3,054	0.879	2.132
Diet No. 3			
Purified	3,299	0.677	1.731
Unpurified	3,330	0.874	2.989

Now the minerals in the amounts shown in these tables are not absorbed in the same quantities as indicated in the analyses. Even the most completely absorbed foods lose some of their minerals owing to defective absorption. Different foods lose according to their composition, but the lowest loss for any food is 25 per cent. Deducting, therefore, 25 per cent from each of the foregoing figures, we get the results given in Table 8.

The responsibility of the sugar and white flour intake in reducing the phosphorus intake to a low level is evident. If losses due to civilized methods of cooking were taken into consideration, the figures given above would be even lower. Most of the minerals in a potato are contained in the fibrovascular layer just under the skin, and this is peeled off mostly, about 35 per cent of the phosphorus being removed. A further 17 per cent is dissolved out in boiling. Peas, beans, cabbage and most vegetables and tubers lose from 25 to 35 per cent in cooking. Now the amounts of calcium and phosphorus required by the body are: 0.023

TABLE 8.—RESULTS AFTER CORRECTION FOR DEFECTIVE ABSORPTION

	Calcium Gm.	Phosphorus Gm.
Diet No. 1		
Purified	0.324	0.999
Unpurified	0.399	1.704
Diet No. 2		
Purified	0.426	0.903
Unpurified	0.660	1.599
Diet No. 3		
Purified	0.507	1.296
Unpurified	0.654	2.241

gm. of calcium for each hundred calories of food eaten, and 0.044 gm. of phosphorus for each hundred calories eaten. In order to compare the results of the foregoing analyses with what is estimated to be the daily requirements of these minerals, Table 9 is given.

It can now be seen how seriously deficient all the purified diets are, whereas all the unpurified or natural diets have adequate amounts of phosphorus. It would seem that the calcium deficiency in these diets may be responsible for dental caries.

TABLE 9.—COMPARISON OF RESULTS OF ANALYSES

	Calories	Requirement of Calcium Gm.	Requirement of Phosphorus Gm.
Diet No. 1			
Purified and unpurified.....	3,668	0.84	1.6
Diet No. 2			
Purified and unpurified.....	3,052	0.71	1.36
Diet No. 3			
Purified and unpurified.....	3,300	0.76	1.45

There have been several pieces of research work which seem to indicate that this is not so.

Klein,[5] in experiments on rats, found that: 1. Rats fed diets low in phosphorus but high in calcium plus large doses of irradiated ergosterol (vitamin D) develop caries of the molar teeth. 2. Rats fed diets high in phosphorus, but low in calcium plus vitamin D do not develop caries of the molar teeth. 3. Rats fed diets adequate in calcium and phosphorus plus vitamin D develop caries of the molar teeth. 4. Rats fed diets adequate in calcium and phosphorus without vitamin D do not develop caries of the molar teeth.

Hewatt, of New Zealand,[6] examined the teeth of children in Tawero School, and compared them with those of the children of a local orphanage. The orphanage children had much better teeth than the school children. Examination of the weekly diets showed that the orphanage diets were much richer in phosphorus than the school diets, which were deficient. Both school and orphanage children received adequate calcium. I[7] examined the teeth of 119 school children at Tsumeb, where the drinking water contains 0.14 gm. of calcium per liter of water. Careful investigation showed that the average child drank at least 2 liters (quarts) of water a day, which meant an addition to the diet of 0.28 gm. of calcium. Nevertheless, an average of 5.6 carious teeth were found.

Karshan and Krasnow[8] found no difference in the blood calcium of carious individuals as compared with those who were caries free or had arrested caries; but there was a difference of 0.4 mg. of phosphorus in the blood of the two groups, the carious groups having, on the average, the lesser phosphorus. During the last four years, I have prescribed

5. Klein, Henry, and Shelling: Relation of Diet to the Toxicity of Viosterol as a Determining Factor in the Production of Experimental Caries in Rats, J. D. Res., to be published.

6. Hewatt, R. E. T.: Dental Caries in New Zealand, New Zealand D. J., 27:27 (Sept.) 1931.

7. Lennox, Joseph: South African D. J., May, 1931.

8. Karshan, Maxwell; Krasnow, Francis, and Krejci, Laura E.: Study of Blood and Saliva in Relation to Immunity and Susceptibility to Dental Caries, J. D. Res., 11:573. (Aug.) 1931.

sodium glycerophosphate in doses of 7½ grains daily to patients subject to the dental carious process, without making any attempt to alter the diet, and without special instructions with regard to prophylactic measures. I have been unable to conduct controlled experiments, but from clinical observation I am able to state that the results are astonishing. In every case, the carious process is immediately arrested, and no new caries has been observed. For the benefit of those who may be skeptical as to whether theoretical diets may be compared with practical diets, it may be mentioned that Sherman[9] made studies of 150 freely chosen American dietaries each covering the food of a group of people for a week or more. They showed the following range and average intake per man per day and per 3,000 calories: phosphorus minimum, 0.60 gm.; average, 1.58 gm.; maximum, 2.79 gm. These analyses were made on the food as purchased and therefore does not take into consideration losses from cooking and from preparation for cooking, nor losses due to defective absorption. One may conclude that most of those practical diets were deficient, and the question of mineral deficiency becomes of practical importance.

9. Sherman, H. C.: Chemistry of Food and Nutrition, Ed. 3, New York: The Macmillan Company, 1926, p. 271.

Commercial Union Buildings, St. George's Street.

REPORT OF PROBABLE CASE OF VICARIOUS MENSTRUATION

By LEON R. CAHEN, D.D.S., New York City

A nurse, aged 23, came to the dental clinic suffering from a fairly severe hemorrhage from a lower molar tooth socket.

Examination revealed a definite oozing from the wound where the molar tooth had been extracted. There was no laceration of the investing tissues, but some slight evidence of clot formation. There were no other symptoms and a roentgenogram of the area was negative.

The patient gave the following history: The tooth in question had been extracted eight days prior to this visit and she had made an uneventful recovery. The usual amount of postoperative bleeding occurred for about six hours, and, for the following week, the patient gave no further thought to her mouth. The present hemorrhage had suddenly begun the evening before her visit to the dental clinic and had continued throughout the night. An iodoform gauze pack, well compressed in the tooth socket, soon brought an end to the bleeding.

On being questioned, the young lady mentioned the fact that her menstrual flow had begun the previous evening and was unusually severe.

The following day, the flow subsided and there was no further bleeding from the tooth socket. The bleeding and coagulation time were within normal limits. The medical consultant's diagnosis was vicarious menstruation.

This clinical diagnosis is of an empiric nature as it is remotely possible that the hemorrhage which occurred eight days subsequent to the extraction was merely a secondary hemorrhage, and the occurrence of the normal menses coincidental.

PROCAINE TOXICITY: ITS PROPHYLAXIS AND TREATMENT*

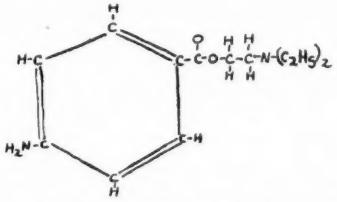
By RALPH M. WATERS, M.D., Madison, Wis.

SINCE the dentist finds procaine or its various substitutes[1] an almost indispensable drug, it would seem worth his while to discuss the many unpleasant as well as dangerous manifestations of toxicity which may result from the injection of local anesthetic agents. This toxicity depends roughly upon five conditions.

*From the Department of Anesthesia, Medical School, University of Wisconsin.

*Read before the Dane County Dental Society, Madison, Wis., May 11, 1933.

1. Procaine is also sold as novocaine, spinocaine, neocaine and under various other designations. Since the first production of procaine about 1905, many other similar drugs have been produced, all having the property of blocking nerve transmission. The structural formula for procaine is represented thus:



A substitution of one radical in a single bond of any one of the carbon atoms in such a chemical molecule may materially change the character of the resulting drug. The possible resulting chemical compounds similar to procaine are obviously infinite. Hence, chemists have been busy since 1906 attempting to produce new chemical entities with the hope of finding one which will have better or longer lasting anesthetic qualities with less danger of individual idiosyncrasy and with less general toxicity as well as damage to tissue at the site of injection. Such attempts, up to the present time, have met with little success. New drugs appear at the rate of at least one or two a year. New local agents require long and tedious study in the pharmacology laboratory before a definite superiority to procaine can be established. So far, no substitute for procaine has been given a sufficiently positive superiority to warrant its clinical use in other than an experimental way. The drug sold as procaine or novocaine by most American drug houses is probably still the safest and most reliable for all injection anesthesia.

SUSCEPTIBILITY OF THE PATIENT

People vary as to sensitivity to this drug. Just as certain people find ragweed or cat's fur the cause of severe disturbance to their physical well-being, so there are certain individuals who cannot tolerate even the proximity of procaine without an unpleasant reaction. A dentist in a nearby state drew total disability compensation from an insurance company because he acquired a skin rash on his hands whenever he handled procaine in his office. Even the use of rubber gloves failed to prevent the difficulty. The insurance company at that time recognized the necessity of the use of procaine if the man were to practice dentistry and therefore admitted total disability. Manifestly, such an arrangement could not be maintained indefinitely, and a compromise was arranged after several months. Cases have been recorded in which a small injection of procaine was followed by a severe angio-

neurotic edema, asthmatic attack or other serious manifestations. The more usual immediate results of procaine toxicity are represented by the list of signs and symptoms which follows, but the rarer effects, which are probably in the nature of allergic or anaphylactoid phenomena, should be kept in mind when unusual physical changes follow the use of local anesthetic agents. Susceptibility varies from the extremely sensitive person, illustrated by the above mentioned dentist, to the occasional individual who can tolerate the injection of several grams of procaine without untoward results. It is unlikely that a single dental office will be visited by many persons with extreme susceptibility to procaine poisoning. The majority of reactions can be avoided by recognition of the following four guides as to technic of injection and by the use of prophylactic and therapeutic measures.

TOTAL WEIGHT OF DRUG INJECTED

Since many times the total quantity of procaine likely to be used in dentistry is regularly employed during the major blocks necessary in surgery, the dentist need scarcely consider quantity of the drug as a major danger in other than exceptional cases.

STRENGTH OF SOLUTION

As to the strength of the solution, the dentist may readily be in error. Toxicity increases with increasing concentration of solution, but in a geometric ratio, not an arithmetic one. Two cubic centimeters of a 1 per cent solution is four times as toxic as 2 c.c. of a 0.5 per cent solution, and 2 c.c. of a 2 per cent solution is sixteen times as toxic as the same amount of a 0.5 per cent solution. It is extremely important for the dentist to appreciate this fact. In bad risk patients, it might often be worth while to dilute the usual solution to one-half or one-quarter the routine strength.

RATE OF INJECTION

With a given concentration of procaine, the more rapidly the fluid is injected, the more likely is a reaction to occur. Slow injections develop less pressure in the tissues and result in less rapid absorption into the blood vessels. If the needle tip should be inadvertently placed inside a blood vessel, an overwhelming dose of procaine is less likely to reach vital centers at one time. The slower the injection, the safer the result.

VASCULARITY OF THE PART INJECTED

Injections into hypervascular areas are more apt to cause toxicity than are injections of similar amounts and concentrations into relatively avascular parts. This fact is intimately related to dental work because no region of the body is so well supplied with blood vessels as is the region of the oral cavity. Add to this the congestion accompanying acute or even chronic inflammation, and the dentist is confronted with an area for injection most likely to promote rapid systemic absorption of procaine and resulting toxic reactions.

SYMPTOMS AND SIGNS OF LOCAL ANESTHETIC REACTIONS

Since epinephrine (adrenalin, suprarenin) is commonly added to solutions injected to produce anesthesia, and since this drug is quite as toxic as is procaine itself, it will be necessary to include both in the following discussion. It might be fair to inquire as to why the toxic epinephrine need to be added at all. There are two reasons. First, epinephrine has a very definite beneficial result in the fact that it contracts the lumen of the blood vessels in the area injected. Thus, two results are assured;

namely, less rapid systemic absorption of the procaine injected and, as a further result, a more prolonged effect, while at the same time the chance of procaine toxic reactions, which, as we have seen, may follow rapid absorption, is decreased. Secondly, epinephrine is a very efficient circulatory stimulant and gives some evidence that, in a normal individual, it may act, within limits, as an antidote to the toxicity produced by the use of procaine. Unfortunately, nearly all the symptoms and physical signs mentioned below can, in certain abnormal individuals, follow the use of either epinephrine or procaine. Clinically, the pulse rate early in a reaction always serves to distinguish the two for all practical purposes of diagnosis and treatment.

Symptoms.—The commoner symptoms which a patient may experience during a local anesthetic injection and which are evidence of toxicity are: 1. Palpitation. The words of the patient often are that he feels a "pounding in the chest" or that his "heart pounds." 2. Faintness. Sometimes this is expressed as "dizziness," "whirling in the head," etc. 3. Apprehension, varying from a mild feeling that "all is not well" to a definite fear of impending death. 4. Shortness of breath. 5. Precordial pain. 6. Nausea.

Physical Signs.—The commoner physical signs noted by the anesthetist during a local anesthetic injection and which are evidence of toxicity are: 1. Pallor. 2. Cyanosis. 3. Extreme change in pulse rate. If the anesthetist will make it a habit to note the pulse rate before injection is begun, realizing that it is often fast at that time because of apprehension or fear, and that it will probably decrease somewhat as fear is allayed, he will then have some idea of what to take as a normal rate for that patient. A marked rise in pulse rate accompanied by other signs of toxicity leads to the conclusion that epinephrine is causing the reaction. A marked slowing of the pulse rate to 60, 55, 50 or less, together with other signs and symptoms, may be taken as evidence of procaine toxicity. 4. Low blood pressure. 5. Vomiting. 6. Excitation, which may be manifest by talkativeness, hilarity, irrationality and inability to sit still, ending in tremors or convulsions. 7. Unconsciousness.

TREATMENT

The treatment of the reactions likely to accompany and follow local anesthesia injections should, like all therapeutic endeavors, be resolved into prophylactic measures and combative efforts. For the comfort of the anesthetist as well as the safety of the patient, prophylactic measures here, as elsewhere in therapeutics, will be found the more satisfactory.

PROPHYLAXIS

Choice of Patient.—A person who has had an injection anesthesia in the past, accompanied or followed by a severe reaction, may wisely be subjected to some other plan of pain relief. A marked reaction at the beginning of injection is often sufficient reason for abandoning the injection and the substitution at a later date of some other method.

Barbituric Acid Derivatives.—Regardless of susceptibility to procaine toxicity, it is probable that every patient who is to be subjected to block anesthesia should be given the benefit of the prophylactic administration of some drug of this group in premedication. All the barbituric acid derivatives act in some degree as cortical depressants. Tatum and his co-workers have definitely demonstrated that the convulsive manifestations of procaine toxicity can be prevented

by the previous use of barbiturates. Since in many fatal cases of procaine poisoning, the patient dies during a convulsion, the advantage of prophylactic barbiturate therapy is evident. Further, if one appreciates that oxygen want is a factor in many cases of procaine reaction, it is clear that artificial respiration can be accomplished easily only if convulsions are absent. There is, in addition, abundant clinical evidence that, when procaine is administered after barbiturates, the less severe signs of toxicity, such as fainting, pallor and apprehension, are much less frequent and less severe when they occur.

Some form of barbituric acid derivative is therefore indicated before every injection of procaine. Barbiturates are as numerous as are the various drugs advocated to replace procaine, new ones appearing each month. It should suffice the dentist to realize that, in general, the toxicity and therefore the dose of different barbiturates varies greatly and that the length of action varies, roughly, inversely with the toxicity. That is to say, a barbiturate of which one may administer 10 grains by mouth without causing noticeable embarrassment to the patient in carrying on the ordinary activities of life will be removed from the body much more slowly than will one of which three grains may cause unconsciousness. It is evident that, for office practice, the barbiturate that is more toxic and of brief action is preferable. The drug of this group filling these requirements most definitely and in common use at the present time is sold as pentobarbital. From 1 to 2 grains by mouth should be ample for prophylaxis of procaine toxicity. When it is administered from fifteen to thirty minutes previous to injection, the maximum effect may be expected at the time of operation. Any depression resulting will have passed off by the end of the operation in most cases, so that minimal inconvenience is experienced postoperatively. It is important to realize that although barbiturates may produce very sound slumber or even unconsciousness in larger doses, no member of this group has anything but a very secondary effect in relieving pain. Other agents must be used to relieve postoperative pain.

Procaine-Epinephrine Balance.—It has been found that the average individual best tolerates solutions of procaine, of any concentration, to which are added 5 minims of epinephrine[2] (adrenalin) 1:1,000 solution, to each 100 c.c. of procaine. This concentration of epinephrine is most suitable probably because a maximum local effect in contracting blood vessels results, while little or none of it is absorbed systemically in this concentration. Certain individuals are extremely sensitive to epinephrine. The most common example is the person with a hyperactive thyroid gland. Epinephrine can best be omitted in preparing the anesthetic solution for such patients. If the very slow injection advised above has been begun, in a supposedly normal individual, using the 5 minims per hundred cubic centimeters solution, and a beginning reaction is noted, the anesthetist should immediately determine whether a rise or a fall in pulse rate accompanies the reaction. If the pulse rate has risen markedly, an epinephrine (adrenalin) reaction may be diagnosed and the remainder of the injection can be made slowly with a solution containing no epinephrine. On the other hand, if the signs and symptoms of reaction are accompanied by a marked decrease

2. This drug may be purchased in dilute solution (1:2600) in ampules containing 1 c.c. Such an ampule represents the 5 minims of 1:1,000 solution suitable to add to 100 c.c. of procaine of any concentration. Ready prepared procaine solutions are also available not only with various concentrations of procaine, but also with or without epinephrine.

in pulse rate, the injection must be interrupted temporarily and, during the interruption, 5 minims of 1:1,000 epinephrine may with benefit be injected into the muscles. When the signs and symptoms of toxicity become less definite, the injection may be finished.

Choice of Strength of Solutions.—It should go without saying that the lowest drug concentration capable of producing the desired effect should be used. Particular attention should be paid to the bad risk case in this regard. Many times, a 0.5 per cent solution can be made to take the place of a 2 per cent solution in old or weak persons. Similar considerations apply to the total quantity of solution injected.

Technic.—In mentioning the causes of toxicity, several factors in technic were mentioned. Other things being equal, the slow deliberate injector will see fewer reactions than will the quick impatient one. To speak of a deliberate injection of such small quantities as 0.5 c.c. may seem ridiculous, and yet I believe that the dentist will find it well worth while to introduce his solutions during as long a period as possible. There are two means at one's disposal in avoiding intravascular injection. In relatively avascular areas, constant movement of the tip of the needle back and forth in the tissues may avoid the possibility of a large quantity of solution entering a vessel. This method is efficacious in regions where vessels are small and the less concentrated solutions are being used. In vascular areas, and when more concentrated solutions are being used, it is essential to aspirate frequently with the syringe with a hope that blood will appear in the syringe if the needle tip is in a vessel. Even with the greatest care, it is probable that reactions are frequently the result of direct intravascular injection.

COMBATIVE TREATMENT

Once a reaction is encountered, what can one do to prevent a grave outcome?

When the Reaction Is Mild.—If only mild signs and symptoms are present, interrupting the injection may be sufficient. Omit epinephrine when injection is resumed, if the pulse is fast. Give epinephrine intramuscularly if the pulse is slow. Lower the head. Stimulate respiration by allowing the patient to inhale aromatic spirits of ammonia or other respiratory stimulants.

When the Reaction Is Severe.—To restore to and maintain oxygen in the cells of the body is of the utmost necessity. Artificial respiration immediately, with or without oxygen, is the one life-saving measure. Time is the important element. If to inflate the lungs with pure oxygen means stepping across the office to reach an oxygen cylinder, omit the oxygen and blow your own expired air directly into the patient's nose or mouth. Do this regularly and persistently, meantime lowering the head of the patient. Be sure that the chest of the patient is actually inflated each time you blow. If the patient is in a convulsion, it may be difficult to inflate the chest. Nevertheless, you must accomplish such inflation. Continue constantly to inflate the chest rhythmically from your own lungs until compressed oxygen or other mechanical means is brought to relieve you. Do not go for added supplies or aid. Intravenous barbituric acid would doubtless stop the convulsion, provided the injection could be made by a helper. Persistent and thorough inflation of the chest is essential. Direct mouth to mouth, or mouth to nose, artificial respiration is always instantly available. Attention to this fact will save most if not all patients in case of procaine poisoning.

THE STATUS OF PULPLESS TEETH AS INTERPRETED BY TISSUE TOLERANCE AND REPAIR FOLLOWING ROOT CANAL FILLING*

By EDGAR D. COOLIDGE, D.D.S., M.S., Chicago, Ill.

UNTIL about fifteen years ago, the life cycle of a tooth was considered to be at an end when it could no longer be retained with comfort by the patient. During the last ten years, further studies in roentgenology, histology, pathology and bacteriology have developed more severe tests for the pulpless tooth. Roentgenographic studies have revealed pathologic changes of the tissues surrounding the root ends of pulpless teeth to such proportions that important changes in attitude of both the medical and dental professions and the public at large have resulted. While many teeth have been sacrificed, much good has come from this forward movement. Operators are more careful in methods employed to conserve the life of the pulp and consider the treatment of the pulp and filling of root canals as a surgical procedure requiring the utmost care to prevent introducing infection into the periapical tissue. If the operator undertakes root canal treatment, he is more conscious of the responsibility attending this part of practice.

The reaction against the pulpless tooth has grown because of the difficulties and uncertainties surrounding the results of treatment. Rather than persistently attempting to master these difficulties and obtain unquestioned results, many have taken the easier road to extraction. Occasional reports gathered from hospitalized patients representing a very small percentage of the public at large have caused some to question the wisdom of ever saving pulpless teeth for the great mass of people in good health.

Rhoads and Dick[1] have recently reported an interesting study of roentgen-ray negative pulpless teeth by quantitative cultural methods. Their findings support findings of Haden.[2] They show that many teeth of patients under hospital care, mostly those suffering from some type of systemic disturbance, are foci or potential foci of infection. On analysis, the report of Rhoads and Dick shows that fifteen of the teeth used in the test were molars, eleven were bicuspids and three were anterior teeth. Three of the molar teeth were badly infected, showing a total bacterial count representing about 93 per cent of the whole count.

The report shows that there is much yet to be done to overcome the unsuccessful results in the treatment of root

*Read before the Odontographic Society of Chicago, Dec. 5, 1932.

*From the Research Department (Director, Rudolf Kronfeld) of the Chicago College of Dental Surgery, Dental Department of Loyola University.

1. Rhoads, P. S., and Dick, G. F.: Roentgenographically Negative Pulpless Teeth as Foci of Infection, Results of Quantitative Cultures, J.A.D.A., 19:1884 (Nov.) 1932.

2. Haden, R. L.: Dental Infections and Systemic Disease, Philadelphia: Lea & Febiger, 1928.

canals. One element of encouragement is found in the fact that almost half of the teeth reported show up fairly well, with a count so low and so close to the control count that it is of practically negligible importance to the report. The history of these teeth is lacking. If it were possible to learn the case histories in detail, it is quite likely that much of this infection would be attributed to carelessness and improper methods of treatment. It is evident that greater

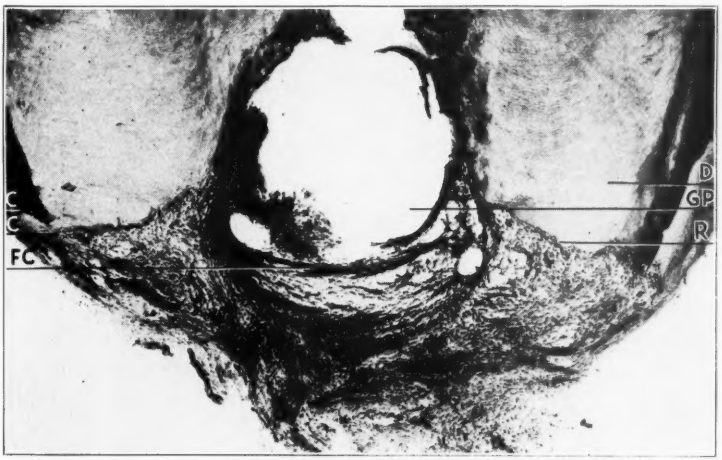


Fig. 1.—Apex of lingual root of man, aged 48. The pulp was removed and the root canals were filled six months previous to extraction. *GP*, space occupied by guttapercha canal filling. *D*, dentin. *R*, line of resorption in dentin caused by inflammatory reaction following pulp removal and canal filling. *C*, cementum laid down before pulp removal. *C'*, new cementum beginning to form. *FC*, capsule of fibrous connective tissue forming around root filling material.

care must be exerted in treating root canals, if this form of practice is to continue. The standing of the pulpless tooth will be determined by cross-sections of work from many operators in different localities. The average work must be on a higher level or frequent reports similar to this will soon bring further reaction against pulpless teeth.

We find ourselves at this time facing the prospect of opposition to all forms of pulp treatment because of the potentiality of root filled teeth as foci of infection. Just what the importance of a potential focus of infection may be has not been established. Caylor and Dick[3] arrived at the conclusion, in 1922, that, after the first years of life, all tonsils have undergone pathologic changes and harbor micro-organisms. They decided that quantitative bacteriology was of more aid than qualitative bacteriology to determine their actual condition. However, not all tonsils are removed at the present time in healthy patients because of their potentiality. Keilty[4] called attention to the difference between a focus of infec-

3. Caylor, H. D., and Dick, G. F.: Qualitative Bacteriology of Tonsils, J. A. M. A., 78:570 (Feb. 25) 1922.

4. Keilty, R. A.: Tonsils as Foci of Infection, J. M. Res., 45:315 (June-Sept.) 1921.

tion as a potential source of trouble and the one that is continually unloading infective material into the circulation.

Some difference of opinion exists as to the value of quantitative methods in bacteriology. Those of us who are not engaged in bacteriologic research are somewhat confused by the report of Rhoads and Dick, because, if we assume that only those teeth showing an excessive count of colonies are dangerous, we have to satisfy ourselves that the others of low count must be relatively safe to the individual organism. On the other hand, if we recognize only the qualitative method, we are at a loss to understand how to classify the controls with vital pulps that also have fairly high counts. This is in accord with the statement from Holman,[5] who says that dangerous confusion sometimes results in overstressing the presence of bacteria and diverting attention from infection.

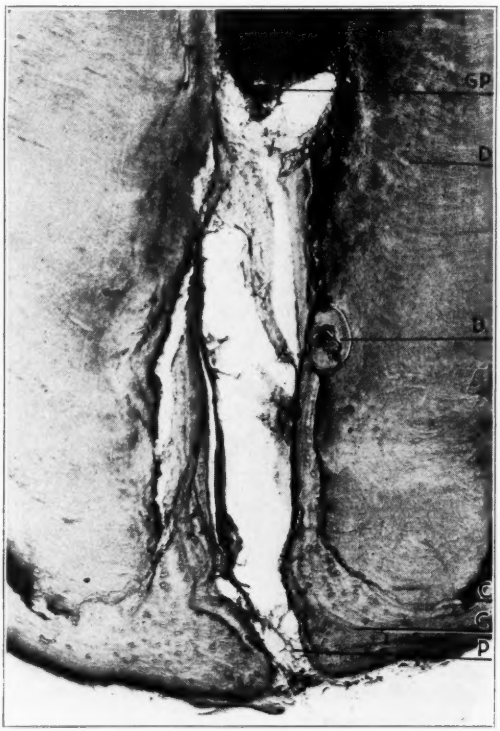


Fig. 2.—Apex of mesial root of case shown in Figure 1. *GP*, end of guttapercha filling. *D*, dentin. *D'*, denticle. *C*, primary cementum. *C'*, new secondary cementum formed along line of resorption on primary cementum and dentin lining walls of pulp canal as well as forming new apical contour. *P*, remaining atrophic pulp tissue. The cementum deposits are part of the healing process following pulp removal.

5. Holman, W. L.: Focal Infection and "Elective Localization," Arch. Pathol. and Lab. Med., 5:68-136 (Jan.) 1928.

Is it good practice to deprive thousands of the comfort and function of natural teeth because a very small percentage of these teeth may become foci of infection? The fact that micro-organisms can be recovered from the crushed and powdered apices of teeth with root canals filled in the mouths of patients who are suffering with systemic disorders does not prove that all of these roots were foci of infection or a source of disease. Authorities are divided as to the exact rôle of focal infection in relation to systemic disease. In most instances, the general resistance of the patient is built up by proper treatment at the time that pulpless teeth are removed, and the assumption that the removal of the teeth effected the cure is unfounded. Even the terms "focus of infection" and "focal infection" are confused. Billings[6] described a focus of infection as "a circumscribed area of tissue infected with pathogenic micro-organisms." Holman states that focal infection implies that (1) "there exists, or has existed, a circumscribed lesion or focus;" (2) "the lesion is of bacterial nature and, as such, is capable of dissemination," and (3) "from the focus there has resulted systemic infection of other contiguous or non-contiguous parts." In his conclusion, Holman makes the following statement: "When a focus of infection is discovered and is considered responsible for a diseased condition elsewhere, it requires the highest type of diagnostic ability to prove that this is true. The

Fig. 3.—Apex of one root of lower second molar of man, aged 50. The root had carried a guttapercha canal filling for many years. *C,* cementum of later period of deposit formed on other cementum of earlier deposit just above. *FC,* fibrous capsule of connective tissue surrounding particle of chloropercha which had been forced beyond foramen. It was well tolerated by the periapical tissue for many years and did not interfere with the healing process by new cementum deposits.

6. Billings, Frank: Focal Infection, New York: Appleton & Company, 1918.

cure of the patient after removal or treatment of a suspected focus is generally considered the most convincing evidence that the focus was the source of the infection. However, such an outcome may be due to a general tonic stimulus resulting from the removal of one cause of a lowered systemic resistance."

To extract well filled pulpless teeth as potential foci of infection without clinical or roentgenographic evidence to substantiate such assumption seems to the dental profession as unsound as removing healthy tonsils, appendixes, gallbladders or prostate glands as potential foci of infection would seem to the medical profession. The argument based upon the simplicity of the removal of the teeth and the possibility of replacing them with artificial substitutes should not be a factor in making recommendations. Just when should a tooth be considered a potential focus of infection? Bacterial invasion of the dentin has been shown to begin at the time the enamel cap or cementum is penetrated by external agencies, with an ingress of micro-organisms. Living pulps have been shown by Henrici and Hartzell[7] to harbor micro-organisms in a large percentage of cases. It will be exceedingly difficult to set a definite time when a tooth may become a potential focus of infection without clinical evidence or any other evidence except such as may be found by microscope or by bacteriologic test. There may be occasions when other clinical history of a patient may justify the removal of teeth without clinical evidence of abnormality except that they are pulpless,

Fig. 4.—*D*, two fragments of dentin evidently forced beyond apical foramen of lower molar in process of cleaning and filling canal. They are well tolerated by the tissue. *C*, cementum of root apex.

7. Henrici, A. T., and Hartzell, T. B.: Bacteriology of Vital Pulps, J. D. Res., 1:419 (Dec.) 1919.

but there must be other times and conditions preceding pulp removal when the same organisms are present and more virulent than in a well filled pulpless tooth. Gardner[8] makes a conservative statement in saying that "the extraction of pulpless teeth concerning which roentgen-ray evidence is negative should be done as a last resort." He recommends cooperation between physicians and dentist.

Extremes in medical and dental practice have probably helped to point out the safest procedure in many instances and may be the means of directing our attitude toward pulpless teeth into its proper channel. Perhaps the most beneficial result of this great change in attitude toward pulpless teeth is to be found in the new determined effort by both the profession and the public to prevent pulp disease by more careful mouth hygiene and more frequent examination by the dentist.

DIAGNOSIS

When a diagnosis of disease of the apical periodontal tissues is made by interpretation of roentgenograms showing opaque shadow images of the structures and radiolucent areas of bone changes that have occurred, it should be kept in mind that the shadows and radiolucent areas are only contrasts of tissue density. These contrasts are indicative of the effects of an inflammatory reaction which has taken place and which does not necessarily indicate the presence of a focus of infection. Frequently, teeth containing vital pulps are found to show dark areas around their root apices when sub-

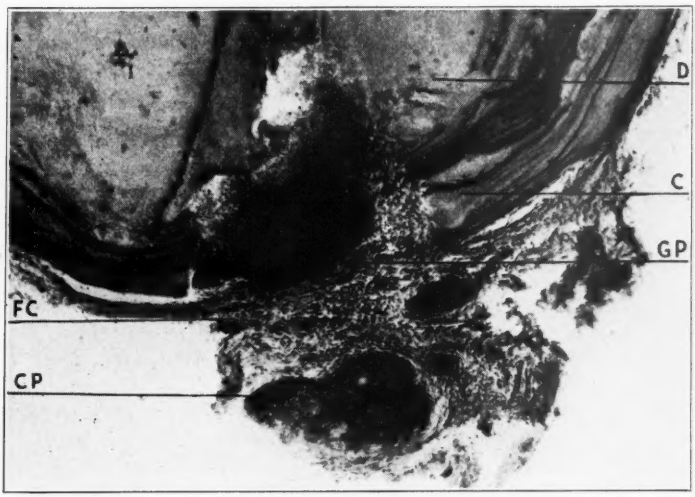


Fig. 5.—Apex of distal root of tooth shown in Figure 4. The tooth was extracted four months after canal filling because of a fracture. *GP*, guttapercha canal filling. *D*, dentin. *C*, cementum. *FC*, fibrous capsule of connective tissue forming across end of guttapercha and enclosing island of chloropercha (*CP*).

8. Gardner, B. S.: Dental Infection as Etiologic Factor in Certain Diseases, with Special Reference to Management of Pulpless Teeth, D. Cosmos, 74:211 (March) 1932.

mitted to the roentgen rays. Such dark areas are quite frequently associated with acute suppurative and chronic ulcerative pulpitis. These areas indicate changes in the periodontal tissue due to inflammation in the pulp, but they should not be classed with gross areas of bone destruction due to chronic infection about roots of pulpless teeth.

Other types of such areas are found about the roots of teeth which have been subjected to a mechanical injury such as overfunction, which Box has termed traumagenic occlusion. Also, they appear after a mechanical injury, as can be frequently observed a few weeks after removal of a vital pulp and filling of the canal. If the apical foramen is large, the removal of a pulp leaves a wounded surface at the line of separation of the tissue. During the healing process, resorption usually precedes repair until an equilibrium is established. Osteoclasts are replaced by osteoblasts and repair begins. Connective tissue cells replace inflammatory exudate cells and soon healing has occurred by the formation of scar tissue. New bone is laid down and new cementum is deposited on the surface of the root until the normal relation of periodontal tissue has become reestablished.

Kronfeld[9] has recently presented evidence of perfect tolerance of a gutta-percha root canal filling, with ideal tissue conditions in the apical region of a pulpless tooth. Deposit of new cementum and a normal arrangement of newly formed periodontal tissue fibers across the end of the root show a complete healing. This instance of healing, together with other

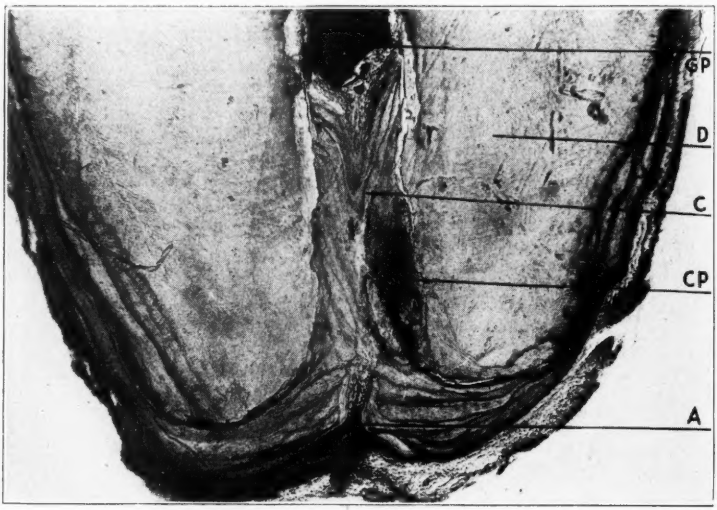


Fig. 6.—Apex of bicuspid root from which pulp was removed in 1909, in a girl 20 years of age. *GP*, end of guttapercha root canal filling. *CP*, chloropercha, evidently crowded beyond the guttapercha during process of filling. *D*, dentin. *C*, cementum deposits following canal filling, embedding particle of chloropercha as it narrowed canal to small channel seen at *A*, apical foramen. The tooth was extracted in 1928 because of periodontal disease.

9. Kronfeld, Rudolf: Present Status of Pulpless Tooth, Bur, March, 1932.

cases of healing shown by Blayney, Grove, Skillen, Boulger, me and others, furnishes an increasing mass of evidence of the possibility of a tolerance of pulpless teeth according to biologic principles.

In Figures 1 and 2, the roots of a molar tooth of a man 48 years of age are shown filled with guttapercha. The pulp was removed under local anesthesia and exposed guttapercha that slightly protrudes from the foramen. The root end shows evidence of resorption that has taken place but which had at the time of extraction been discontinued. Cementum building had begun at many places. Healing was well under way and no doubt in another six months or a year, a healed condition would have been shown. The

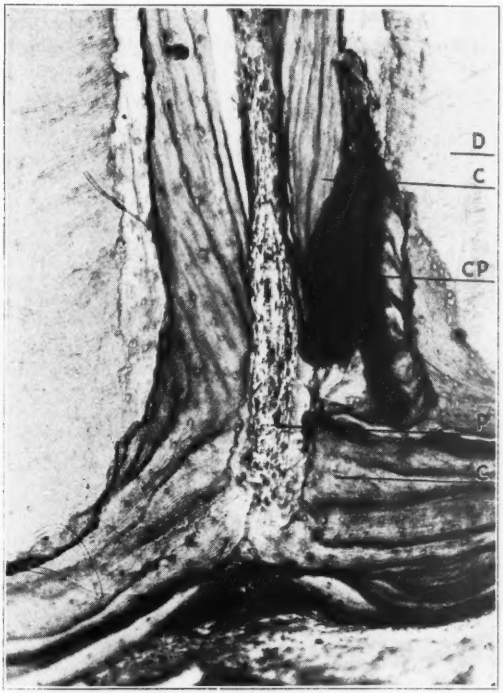


Fig. 7.—Higher magnification of root shown in Figure 6. Consecutive layers of cementum narrow the canal to a small portion of its original diameter. *P,* remains of pulp tissue. *CP,* chloropercha almost completely healed in with cementum. *C,* cementum. *D,* dentin.

the roots subsequently filled with guttapercha. The tooth was extracted about six months later. Figure 1 shows the lingual root, which was slightly overfilled. The guttapercha was mostly lost in sectioning the root, but the fibrous tissue capsule can be seen forming across the distal root is not shown, as very little periodontal tissue came away when the tooth was extracted. The mesial root, which was slightly underfilled, is shown in Figure 2. A more desirable condition is found here and it illustrates a principle: In a canal containing vital pulp

tissue free from infection, conditions are more favorable for the forces of repair if the pulp is severed close to the apical foramen, and the root filling then extended to the pulp stump. This would afford a pulpless tooth with a little living tissue within the apex of the root, the filling extending to it but not protruding beyond the foramen. There is greater evidence of new cementum formation at the apex of this root and along the walls of the canal than in the other two pictures.

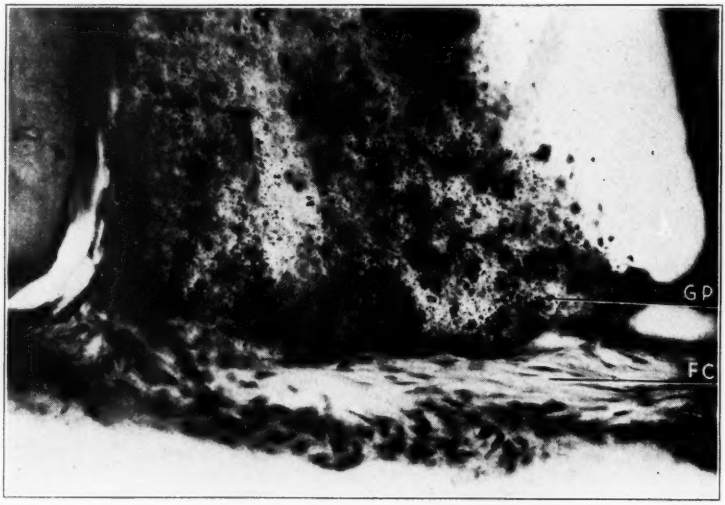


Fig. 8.—Apex of bicuspid root of man, aged 50, which was refilled in 1919 and extracted in 1928 because of marginal periodontitis. *GP*, end of guttapercha filling. *FC*, fibrous connective tissue adjacent to guttapercha. It shows no inflammation and indicates a high degree of tolerance to guttapercha as a root canal filling.

This is probably due to a more mild inflammatory reaction following the canal filling, tolerance being more readily established than where a foreign body irritant had to be encapsulated, as in Figures 1 and 2.

Complete encapsulation and evidence of healing around bits of guttapercha or chloropercha have been frequently shown. In Figure 3, guttapercha is shown encapsulated in fibrous tissue. Cementum repair can be seen progressing on the root apex above.

The two fragments of secondary dentin shown in Figure 4 were evidently forced through the apical foramen in the process of cleaning and enlarging this molar canal in a woman of middle life. These fragments are well tolerated by the tissue, which shows little inflammatory reaction at the time of the extraction of the tooth, four months after the filling of the canal, owing to an accident that caused the tooth to split. In Figure 5, the other root of the same tooth is shown with a little fragment of chloropercha and a small fragment of dentin embedded in the soft tissue. The inflammatory reaction following this canal filling was slight, as can be observed by the smooth condition of the cementum and the absence of inflammatory exudate cells in the

region of the canal filling or of the fragments embedded in the periodontal tissue. Tolerance to this foreign substance has rapidly developed even within the short time since the root canal was filled.

The apex of a lower bicuspid shown in Figure 6 again illustrates the principle of severing the pulp close to the foramen and filling to the pulp stump. The history of this tooth, in a girl, aged 20, shows that the pulp was removed in 1909 and the canal filled with guttapercha. The roughened border of the dentin and atrophic in character remained when the tooth was extracted many years later, in 1928. A small piece of chloropercha had been forced beyond the guttapercha cone and lies against the dentin wall. It is completely "healed in" in secondary cementum. It is better shown in Figure 7, with greater magnification.

A bicuspid root of a man of 50 years is shown in Figure 8. The tooth had been refilled in 1919 and extracted in 1928 because of marginal periodontitis. For nine years, the tooth was in service after re-

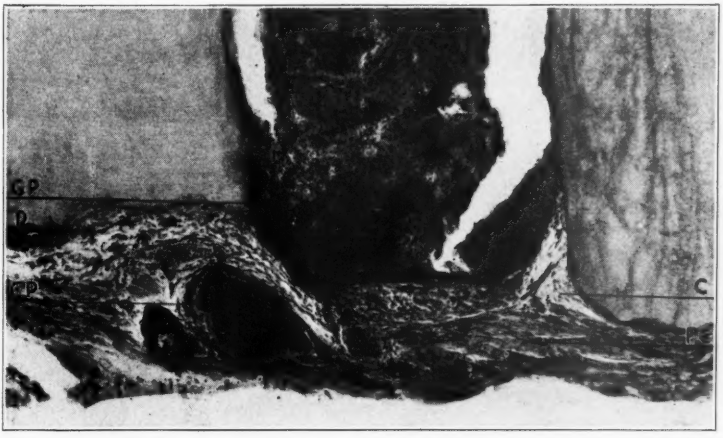


Fig. 9.—Apex of a cuspid root of a man, aged 60, from which pulp had been removed many years previous to date of retreating and refilling. It showed roentgenographic evidence of periapical tissue disease before refilling and was extracted four years later because of periodontal disease. *GP,* guttapercha filling flush with apex of root. *CP,* chloropercha particles "healed in" in connective tissue. *D,* dentin showing irregular line of resorption. *C,* new cementum forming. *FC,* fibrous connective tissue capsule showing healthy tissue free from inflammatory cells. It shows tolerance and healing even though the root was pulpless before refilling.

cementum of the deposits laid down before pulp removal gives evidence of a period of resorption immediately following the canal filling. Subsequently, layer after layer of cementum has been deposited along the walls of the canal and across the end of the root, until only a mere thread of organic pulp tissue very filling and then, on extraction, we find a picture of tissue tolerance and healing that closely approaches an ideal condition. The guttapercha fills the apical foramen but does not protrude. A fibrous band of connective tissue stretches across the exposed end of the guttapercha, which shows no inflammatory cells. The cemen-

tum over the apex of the root is newly formed, showing a normal vital reaction.

The next two illustrations represent tolerance and repair following refilling of a tooth that had been pulpless for many years. The roentgen-ray evidence indicated bone resorption and a granulomatous area existing in 1920, when the tooth was opened, treated and refilled. It was extracted four years later because of periodontal trouble. In Figure 9, the root end is shown with the guttapercha filling about flush with the end of the root. A few small fragments of the root filling lie healed in in the soft tissue without irritation to the tissue. The dentin of the root end shows that resorption has been in progress, while at several points new cementum deposits can be seen. Since the root was extracted four years after it had been retreated and filled, there seems to have been a period of active change in the periapical tissue followed by the gradual establishment of tissue tolerance, which is evident in this picture. It is not necessary to span a very wide gap in producing evidence of complete healing and repair by cementum on pulpless roots as well as on roots from which living pulps have been removed. In the higher magnification of Figure 10, positive evidence of cementum formation is found, and the soft tissue does not show the characteristics of chronic inflammation which was present, at least by roentgenographic evidence, at the time treatment was instituted four years earlier. When it is taken into consideration that the age of the patient was beyond 50 years when the retreatment of the root was undertaken and the root was extracted four years later, it is evident that even in middle life, the biologic forces of repair are active in the periapical region provided a favorable

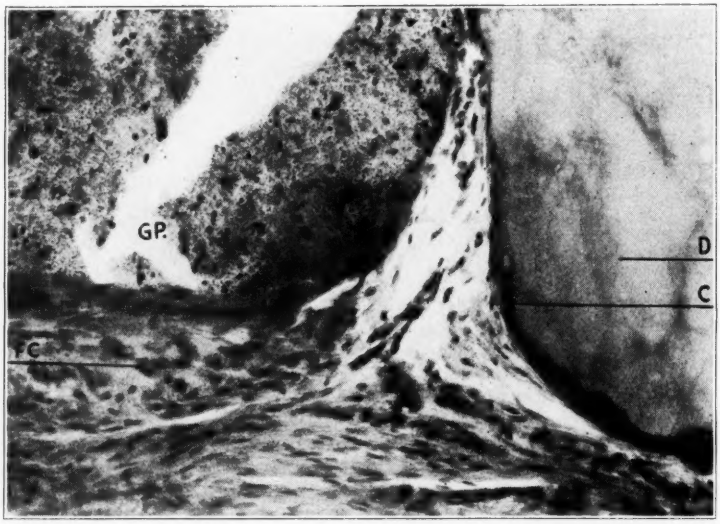


Fig. 10.—Higher magnification of Figure 9, showing new forming cementum at *C'*, fibrous capsule without inflammation. *GP*, guttapercha canal filling. *D*, dentin. There is evidence of healing.

condition can be created by good treatment and root canal filling. A few years ago, a case of root resection was shown[10] wherein cementum had been restored over the entire surface of dentin exposed by resection. Even though a large area of bone destruction and the accompanying diseased tissue were present before resection was undertaken, complete healing followed resection by a new deposit of cementum over the exposed dentin surface, and new periodontal fibers became attached to the new cementum. Similar cases of repair following root resection have been shown by Aisenberg,[11] Blayney and Wach,[12] Blum[13] and Hill.[14]

Findings of the present time indicate that the best results in root canal filling, following pulp removal, are to be accomplished by excising the pulp tissue as close as possible to the apical foramen without injury to the periapical tissue and then inserting the filling to the pulp stump without forcing any of it beyond the apical foramen. In the treatment of pulpless teeth with gangrenous or putrescent pulps, or in re-treating teeth when previous attempts have been made to fill the canal, the requirement is different. In such cases, the infection must be controlled first by germicidal drugs that are able to reach large and small ramifications of the pulp canal. Drugs that do not coagulate protein material nor create an injury to living tissue that cannot be readily healed are considered most practical. The principles laid down by Prinz[15] for germicidal action should be kept constantly in mind. The germicide must have actual contact with the micro-organisms in order to perform its function. It must be of sufficient strength to destroy the micro-organisms in the root canal and must be kept in contact for sufficient time to destroy them. After thorough cleaning and disinfection, the canal should be filled completely to the apical foramen. This is necessary because of the absence of living tissue in the canal and the tendency of unfilled space to accumulate exudate and leukocytes from the periapical tissue, which would soon disintegrate into pus. The presence of this disintegrating organic matter would cause an inflammatory reaction regardless of the presence of micro-organisms. Inflammatory reaction may be caused by mechanical injury, chemical irritation or the presence of micro-organisms. In the former two instances, the reaction should resolve to normal, as soon as the irritant is removed or tolerance is established. In the latter, a continuous irritation would exist, unless the micro-organisms are destroyed. The presence of micro-organisms in a poorly filled root canal whose apical foramen is not well sealed by a root canal filling may become a potential factor at some later time in a focus of infection. By the use of surgical methods in asepsis, by thorough removal of all foreign material and disinfection with germicides followed by complete filling so that the

10. Coolidge, E. D.: Root Resection as Cure for Chronic Periapical Infection: A Histologic Report of Case Showing Complete Repair, J.A.D.A., 17:239 (Feb.) 1930.

11. Aisenberg, M. S.: Root Resection After Four Years: Report of a Case, J.A.D.A., 18:136 (Jan.) 1931.

12. Blayney, J. R., and Wach, E. C.: Study of Tissue Repair Around Resected Root End, D. Forum, 1:58 (Jan.) 1924.

13. Blum, Theodor: Root Amputation, a Study of One Hundred and Fifty-Nine Cases, J.A.D.A., 17:249 (Feb.) 1930; Additional Notes on Root Amputation, Including a Study of Thirty-Two New Cases, ibid., 19:69 (Jan.) 1932.

14. Hill, T. J.: Regeneration of Periodontal Membrane After Root Curetment, D. Cosmos, 73:799 (Aug.) 1931.

15. Prinz, Hermann: Diseases of Soft Structure of Teeth and Treatment, Philadelphia: Lea & Febiger, 1928, p. 195.

apical foramen is sealed, opportunity for a reinfection to occur is reduced to a minimum.

SUMMARY

In the light of the preceding evidence of complete healing where the same biologic activity can be shown that exists around roots containing living pulps, it seems logical to say that pulp removal and root canal filling under conditions similar to those shown are not contrary to biologic principles. The evidence presented was gathered from patients of different types and ages. The results are not attributed to any special technic other than cleanliness and care. The first three cases were in patients of middle life, the next in a young adult and the others in persons of later adult life but below the age of 50 years.

Root canal operations are indicated for patients in good health who are free from disturbances that are recognized as secondary infections. In the latter conditions, when individuals are suffering with systemic disorders which originate from foci of infection, root canal operations are not indicated. The present uncertainty, due to the differences of opinion in members of the professions and the impossibility of proof that roentgen-ray negative pulpless teeth are not foci of infection without the extraction of the tooth to prove it, renders the decision against the tooth in question. Hence, for this type of patient, these operations should not be undertaken.

The treatment of root canals must be considered as no different from treating an open wound in any other part of the human body. It is a responsibility to be met with surgically clean methods of operating, a familiarity with root canal anatomy, a study of tissue reactions and a careful technic.

By earnest cooperation between physician, dentist and patient, together with continued laboratory investigation, the problem of the pulpless tooth and its antecedent problem of pulp involvement will be gradually reduced to rational management. Its laboratory aspect may be solved by a few investigators, but in its clinical aspect it becomes a matter of the interest and skill of many operators in every locality.

CHANCRE OF THE GINGIVA*

By CASPER M. EPSTEIN, M.D., D.D.S., and ERWIN P. ZEISLER, M.D., Chicago, Ill.

THE problem of diagnosis of oral lesions has often been a very perplexing one because many systemic disturbances present manifestations in the mouth. One of the diseases causing a great deal of mental perturbation is syphilis, since its symptoms vary to a large degree with the organs involved.

Extragenital chancres constitute from 5 to 7 per cent of these lesions, and of these about 75 per cent occur about the head. Of this number, about 80 per cent are in the mouth; which emphasizes the fact that the mouth is a site of predilec-

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tion for about 60 per cent of all extragenital chancres. The oral areas affected with the greatest frequency are, in order, the lips, the tongue, the tonsils and the gingiva, and because of the infrequent occurrence of the chancre in the last-named location, the following cases are deemed of sufficient importance to be brought to the attention of the profession.

According to the statistics of Fournier, about 1 per cent of all extragenital chancres occur on the gums. Although a true chancre presents certain definite diagnostic points, the lesion, when appearing on the gingiva, has no distinct characteristic form, and because of this fact, the diagnosis of a primary syphilitic lesion of the gum becomes more difficult than the recognition of a similar infection on the lip or tongue, for example.

It may be argued that the peculiar influence which the oral conditions exert on the lesion, owing to its exposure to moisture and warmth, causing it to be macerated; irritation or injury from eating, drinking or biting (the last named especially in those types of malocclusion in which the gingivae come in contact

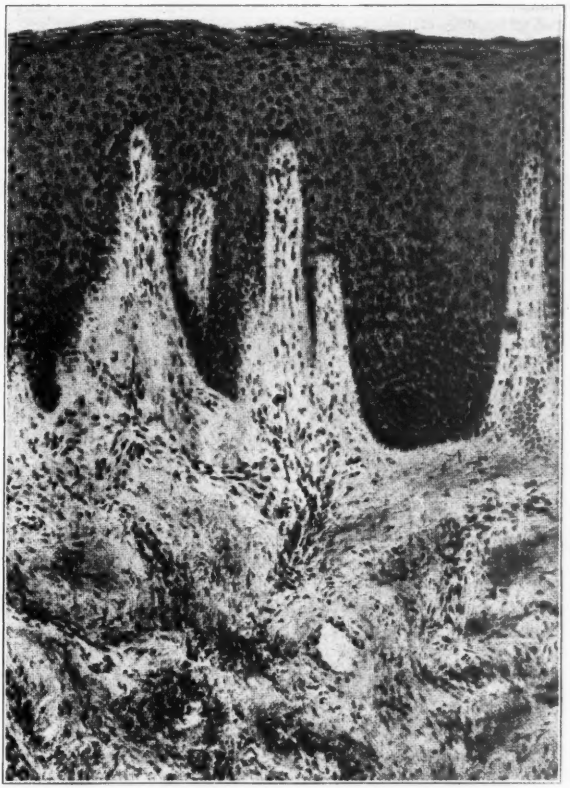

Fig. 1.—Gingiva of normal adult, showing only two layers of tissue. (×100.) (Orban.)

with the teeth of the opposite arch), from the presence of rough, sharp or carious teeth or roots, or of calculus, and from other secondary infections in the mouth, produces the same effect on a syphilitic lesion whether it is on the gums or on the tongue. Maceration produces little variation in the chancre on tertiary lesion, but it causes distinct alteration from their cutaneous types, especially in the lesions of secondary syphilis in the mouth.

Fig. 2.—Vertical section through tongue, showing four layers of tissue. (×25.) (Lewis.)

The reason that the chancre appears differently on the gums as a diffuse, not simple, erosive lesion, from these lesions on any of the other oral structures may be explained upon a histologic basis. The gingiva consists of a layer of stratified epithelium which rests upon tall connective tissue papillae. (Fig. 1.) The lips and the tongue consist of four layers, as seen microscopically; namely, stratified epithelium, tunica propria, submucosa and muscularis. (Fig. 2.) The gingivae rest on bone; whereas, the other oral structures have no osseous foundation. From this difference in anatomic structure, it may be seen that a primary lesion of the gingiva cannot necessarily become quite so deep as a chancre in the other oral structures, since bone involvement does not occur in the first stage of syphilis.

An extragenital chancre within the mouth is more difficult to diagnose because the oral cavity is not usually thought of as a site of a syphilitic infection. Every suspicious lesion of a few weeks' duration, with painless enlargement of the nearest lymphatic glands, which are hard and shotty, should arouse the suspicion of the lesion's being a chancre. A bubo or swelling of the lymph nodes adjacent to the chancre is the most valuable

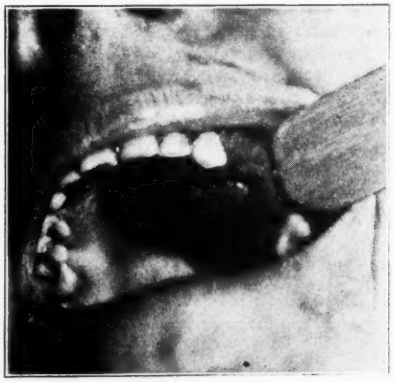

Fig. 3.—Primary erosive chancre of gingiva.

attended with local signs of infection, such as redness and heat, and is not, as a rule, of much concern to the patient. The lymph nodes of the affected submental and submaxillary region are found to be particularly hard when palpated, and may appear in clumps or in a chainlike arrangement. Quite in contrast to the adenopathy of cancer, the bubo of syphilis follows soon after the appearance of the chancre. Unlike genital chancres, extragenital chancres may be painful. In the differential diagnosis, one must rule out fibromatosis gingivae, pyogenic granuloma, benign and malignant epulis, carcinoma and, in rare instances, scleroma.

Fig. 4.—Subepithelial tissues, revealing exudation of polymorphonuclear leukocytes with many plasma cells in some areas.

of the associated signs, particularly in extragenital chancres about the mouth. A syphilitic bubo is not painful, is not

The following case of primary chancre of the gingiva is interesting from several viewpoints: 1. It sharpens the powers

of observation. 2. It teaches thoroughness in diagnosis. 3. It is rather an uncommon clinical entity. 4. It again emphasizes the already well known fact that no part of the human body is exempt from this infection.

REPORT OF CASE

History.—Mrs. I. H., aged 39 years, white, entered the clinic with the following complaints: pain and swelling in left upper jaw for the past five weeks and sore throat during the past week.

About five weeks previously, pain and swelling developed in the left upper first bicuspid region. The dentist extracted this tooth and, since then, there had been pain, swelling of the gingivae and a flow of pus from the socket. Pain radiated upward to the region of the maxillary sinus. At first, the discharge was yellowish white, but now there was a deadlike tissue in the mouth over the region affected.

Examination.—There was slight tenderness over the left antrum. The gingivae of the left upper jaw were swollen and red. The lesion was soft, doughy, tender, dusky red, granulative in appearance and covered with a fibrinopurulent exudate. (Fig. 3.)

The pharynx was hyperemic. Tonsillar crypts contained a grayish white material. There were large and tender glands in both the anterior and the posterior triangles of the neck.

The remainder of the physical findings were essentially negative.

Roentgenograms of the upper jaw revealed no bone disease.

A tentative diagnosis of infection, with a possible neoplasm present, was made and a section taken for biopsy in the oral surgery department.

Fig. 5.—Areas showing fibroplastic proliferation about endothelial buds.

The microscopic report was as follows: Pyogenic granuloma (Fig. 4). There was an irregular downgrowth of epithelial cells, with no evidence of anaplastic cells nor mitotic figures. The subepithelial tissue showed an exudation of polymorphonuclear leukocytes with many plasma cells in some areas. Other areas showed fibroplastic proliferation about the endothelial buds.

Treatment and Course.—The treatment

was palliative and symptomatic until about six and one-half weeks after the patient had the tooth extracted, when she returned with a generalized bilateral and symmetrical eruption on the body, extremities and head.

At this same time, there were headaches, generalized weakness and spells of sweating.

The rash was dusky red and copper colored, and papular in character. Many of the lesions were covered with a dry, dirty gray and somewhat adherent scale. There was very little tendency to coalescence, although the papules were of various sizes. Further examination revealed mucous patches on the vulva.

Both the Wassermann and Kahn tests at this time were strongly positive. The diagnosis of primary and secondary syphilis was made in the dermatology department with the primary lesion occurring on the gingiva.

Under antisyphilitic treatment, the evident manifestations disappeared and the general condition of the patient continued to improve.

The importance of making an early diagnosis of syphilis is so great that mere mention of the fact is certainly insufficient recognition. Modern understanding and comprehension of this disease has definitely brought to light the tremendous importance of making the diagnosis of syphilis in the first stage of the disease, because it is in this period that *Spirochaeta pallida* is most abundant in the site of inoculation and can be demonstrated in the dark-field even when the serologic tests are negative, and because treatment instituted in this stage is the patient's golden opportunity for a cure.

REPORT OF THE COMMITTEE ON NOMENCLATURE OF THE AMERICAN DENTAL ASSOCIATION

IN our report in 1932, we recommended that the Committee be enlarged to include a representative from each of the specialties of dental practice, namely, exodontia, oral surgery, periodontia, orthodontia and prosthetic dentistry. This recommendation was made because we believe that we would receive better cooperation from these sources, and that the recommendations of the committee would be more representative of the general thought on the subject of nomenclature than is at present the case. Indeed, we attribute the lack of support of the work of the committee from some sources to the fact that some of the specialties are not represented on the committee.

As no action was taken on this recommendation last year, we again offer the recommendation, and urge action on it at this time. If the action is favorable, we request that such members be appointed for the coming year.

We are pleased to report that, under the auspices of the International Dental Federation, there has been organized an international association for the study of paradentosis (abbreviated A. R. P. A.), with a number of European and American countries represented, for the purpose of research into the subject of so-called pyorrhea alveolaris, and its first effort has been directed toward simplification of the terminology. As a result of this effort, adoption of the term "paradentosis" to take the place of the term pyorrhea alveolaris has been recommended. They have also tentatively proposed terms to designate the various forms and degrees of paradentosis, on which we shall report later.

Your committee is in accord with the spirit and objectives of the A. R. P. A.

and recommends that the term it has adopted be adopted in this country. This term has been in use for some two years in Europe and, we believe, has contributed much to a better understanding of this common disease, in which so much confusion as to terminology has existed in the past.

In this connection, we also recommend the adoption of the term "paradentium," also in use and adopted by the A. R. P. A., to mean the investing tissues of the teeth. At present, the term "peridentium" is being used in this country to mean the investing tissues of the teeth, but this use is very confusing, for the reason that "peridentium" has long been in use in dentistry to mean the peridental membrane.

We would again define the terms "gingival line" and "cervical line," as there seems to be an impression that these terms are interchangeable.

We would offer a further recommendation with regard to the use of "cuspid," "bicuspid," "canine" and "premolar." While these terms are used interchangeably and are well understood in dental literature, we recommend that the terms "canine" and "premolar" be used preferably in theses or contributions which involve the other biologic sciences. We suggest this modification for the reason that these terms (canine and premolar) are well established in, for instance, anthropology; while the terms "cuspid" and "biscupid" are not understood in the sense in which we use them.

We would again call attention to our recommendation made several years ago as to the use of the term "pathosis" as meaning a disease condition, in preference to the misuse of the term "pathology" in this sense.

DENTAL NOTATION

In recent years, there have been in use several methods of noting the teeth symbolically, or by numbers, for the sake of brevity. We recommend what we believe is a simple and easily understood system of notation, suggested by Dr. Haderup of Denmark and now quite generally used in Europe.

By this method, the teeth are designated by the numbers one to eight beginning with the central incisors, with the symbol plus (+) to indicate the upper teeth and the symbol minus (—) to indicate the lower teeth. For the right side of the mouth, the symbol appears to the right of the number; for the left side, it appears on the left side of the number indicating the tooth. Thus, 1+ designates the upper right central incisor; +1 the upper left central incisor; 1— the lower right central incisor, and —1 the lower left central incisor.

For the deciduous teeth a cipher precedes the number of the tooth.

As an aid in recognizing the side of the mouth intended, we suggest the following simple rule: The side of the number of the tooth on which the symbol appears indicates the side of the mouth, thus: 1+, the right side, and +1, the left side of the mouth.

We believe this system an improvement in notation in that it is simple and does not require extra type characters in printing.

At the suggestion of one of our leading anatomists, your committee has been studying the terminology of the anatomy of the teeth as devised by G. V. Black, with a view to designating some of the occlusal surface markings more distinctly and possibly more differentially.

Our reverence for this grand old man of dentistry and our high regard for the immense value of his contribution to anatomic nomenclature make us extremely diffident in attempting to improve on his work, but we believe that the expe-

rience of anatomists in teaching has shown that confusion in some of the terms that he devised can be eliminated by some suggested revisions. We therefore offer the following:

For the cusps of the first lower molar tooth we recommend mesiobuccal, centrobuccal, distobuccal, mesiolingual and distolingual. For the developmental grooves of the first lower molar, we recommend mesiobuccal, mesiobuccoclusal, distobuccoclusal, distobuccal; distolingual, linguoclusal, mesiolingual; central, mesial and distal (lateral continuations of the central) grooves.

For the surface markings of the upper bicuspid or premolar tooth, we recommend: cusp ridge, buccal and lingual in place of buccal triangular ridge and lingual triangular ridge, respectively; mesial and distal plane of buccal cusp in place of mesiobuccal and distobuccal inclined plane of buccal cusp; mesial and distal plane of lingual cusp in place of mesiolingual and distolingual inclined plane of lingual cusp; mesial and distal arms of buccal cusp in place of mesiobuccoclusal marginal ridge and distobuccal marginal ridge; mesial and distal arms of lingual cusp.

For the developmental grooves of the upper first molar, we recommend central, mesiobuccal, distobuccal, mesiolingual and distolingual, buccoclusal, linguoclusal; for the developmental grooves of the lower second molar, buccoclusal, linguoclusal, mesiobuccal, mesiolingual, distobuccal, distolingual; central, mesial and distal (lateral continuations of central groove).

For the benefit of those who failed to note them when presented, we repeat the definitions of the terms "articulation" and "occlusion" as recommended by the committee to be used in the dental sense.

Articulation. The arrangement of artificial teeth to conform to the requirements of the edentulous space or spaces which they are to occupy, and to serve adequately the purposes of the natural organs which they are intended to replace.

Note: Articulation refers to the actual placing of artificial teeth, one by one, into the required position; but articulation is not to be used to describe the occlusal relations of artificial teeth after they have been so arranged.

Occlusion. The contact of the teeth of both jaws, when closed (together) or during those excursive movements of the mandible which are essential to the function of mastication.

Pathosis. A disease condition. A morbid dissolution of tissues.

Paradentosis (or parodontosis) (Gr. para, about, near; L. dens, tooth and osis, condition of disease). A disease condition of the tissues about the teeth.

Paradentium (or parodontium). The investing tissues about or near the tooth as a group, namely, the pericementum, the gingiva and the alveolar process.

Peridentium (or periodontium). The membranous tissue immediately surrounding the cementum of the tooth and between the cementum and the alveolar process; synonyms: pericementum, peridental membrane.

Cervical line. The line of the anatomic neck of the tooth, to be distinguished from gingival line.

Gingival line. The line of contact of the gingiva to the tooth; to be distinguished from cervical line.

Cuspid; bicuspid. To be used interchangeably with canine and premolar; use of the former to be confined to a strictly dental audience; the latter to be used in addressing an audience including representatives of other biologic sciences.

The committee would also recommend that a compilation of the terms that we have suggested in previous years be published in THE JOURNAL or in pamphlet form or both, for the reason that the profession generally does not appear to be familiar with the terms offered.

Respectfully submitted,

WILLIAM B. DUNNING
JULIO ENDELMAN
L. PIERCE ANTHONY, *Chairman*

IMAGES OF RADON IMPLANTS ON ORAL ROENTGENOGRAMS

By HAROLD ARTHUR SOLOMON, D.D.S., Buffalo, N.Y.

SEVERAL people at the 1932 A.D.A meeting reported that they had been puzzled on finding images of radon implants or "seeds" on oral roentgenograms. As radium therapy is being widely adopted in the treatment of malignancy, it is important that everyone engaged in oral roentgenography be able to recognize roentgenographic evidence of such bodies.

In order that those unfamiliar with radium may recognize implanted "seeds," the accompanying intra-oral film is presented, from the files of the New York State Institute for the Study of Malignant Diseases, at Buffalo. This film shows the images of three interstitial radon implants or "seeds" in an epithelioma involving the inner cheek and superimposed upon the image of the dental structures.

These implants are of solid gold and are approximately 4 mm. in length, having a diameter of 1 mm. and a wall thickness of 0.3 mm. They contain radium emanation which is a gas from which the *alpha, beta* and *gamma* rays are given off. The gold acts as a filter to remove the *alpha* and *beta* rays, which would cause a severe necrosis of the adjacent tissue. Such implants are not removed; but are allowed to remain, either to slough out or to become encapsulated with fibrous connective tissue.

Intra-oral film showing three radon "seeds" in cheek.

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Editorials

CHRISTMAS AND THE SEALS

Mayhap there is a lovelier time of the year than Christmas, but if so it has never been discovered by mortal man. Spring is alluring in all of its ways and full of the most poignant promise—almost a painful bursting of the bonds that have held nature in check through the frosts of winter; summer is the season when buds have turned to blossoms, and blossoms to fruit; autumn is the maturing when the consummation of all growth has yielded in abundance the golden grain and the sun flecked fruit, when nature sighs in her plenty and the ravishment of growth is over. Thus the cycles of the seasons turn in a vast panorama for the delectation of man, each in its own way bringing something of promise and of fulfilment for the sons and daughters of men.

But Christmas is different. Christmas is created mostly by the sentiment of man himself rather than by the bounty or the beauty of nature. It is the warmth of the human heart rather than the

rays of the sun or the glitter of the stars that makes Christmas. What though wintry blasts may sweep the glade, and tingle the cheek, what though blizzards rage and tempests roar, what though nature turns to us a sullen mien and dims the lightness and brightness of fairer days—the spirit of Christmas cannot be conquered. It rises triumphant over the petty woes and strifes of humanity and forces cheer into the hardest hearts. Pity the man or woman who cannot enter into the flavor of Christmas, who cannot absorb some of its joy and its abounding faith. Christmas vitalizes the emotions, and the emotions are the most potent part of life. It is the great jubilee of childhood—at Christmas we are all children once more, or we should be.

Without Christmas the yearly cycle would be barren of sentiment, and without sentiment the very well-springs of our better nature would shrivel up. Let us hail Christmas as the herald of happiness, and the harbinger of cheer and good will.

We of the dental profession have a double incentive to celebrate Christmas. We have the incentive of a common humanity where all men are brothers—brothers in kind if not in blood—and the incentive that comes from the desire, and even the necessity, of bringing succor to our needy fellowmen. Through the medium of the Christmas seals we are yearly building up a fund, the interest on which is being used for the relief of our unfortunate fellow members who through one exigency or another have fallen by the wayside and have been left bereft of the means of self-support.

Since the relief fund was started, no fewer than ninety-seven of our members have received assistance from the Relief Commission, and their latter days have thus been made bearable and even comfortable. In many instances it has meant the difference between abject and distressing poverty with all that this involves in a helpless and miserable old age, and the relief that comes from the few dollars that bring sunshine and cheer into a home.

And remember, it is the home of one of us, one of our own, someone who worked by our side, and labored with us through the heat and the burden of other days. There is something very appropriate and very beautiful in the plan of dental relief, and each year aug-

ments the fund, that a wider circle may be succored. It is especially urgent at this critical time when the general economic stress has made a double demand on our sympathy and our resources. This year every member who has in any way been able to keep his head above water should be only too glad to send in the exceedingly small contribution of one dollar. Times without number it has been emphasized how trivial the amount is to the individual, how great it becomes in the aggregate. Supposing that one of our members should feel the urge to help toward the relief fund, and should determine to put aside a given amount each day toward this worthy project so that at Christmas he might contribute for the seals, he would not be able to do so for the very simple reason that the daily allotment would be so meager that he could not find a coin small enough to contribute. Let us ask how much he would have to save for his daily allowance. In a *month,* less than nine cents, in a *week,* less than two cents, in a *day,* less than one-third of one cent. If at the end of three days he put aside one cent he would, when Christmas came, have more than enough to pay for the seals. There is not an individual practicing dentistry who could not do that much—not one.

And here is something that few of our members consider: they do not think of the amount of time and energy spent by the Relief Commission and Relief Committee to carry on this activity. The work goes on for the most part so quietly and unobtrusively that the rank and file of the membership never have occasion to take cognizance of the labor involved in the machinery of relief. The many hours spent by the personnel in carrying on this work represent a sacrifice compared with which the dollar from the seals is an almost infinitesimal contribution, so small in fact that every member should be only too anxious to send in his dollar the moment the seals are received. The response this year in view of the great need should be as nearly as possible one hundred per cent. Let us make it that.

A REAL CONTRIBUTION

The widespread influence that may be exerted by our health commissioners in conserving the welfare of the children of any community cannot be overestimated. The constructive information that may emanate from a commissioner's office in the way of published instruction to the laity may easily go a long way toward preventing many of the diseases of childhood.

A notable instance of this character comes from the president of the board of health of Chicago, Herman N. Bundesen. Dr. Bundesen has just issued a booklet on "The Care of the Teeth" to be distributed to the public. It is the Oct. 23, 1933, number of *Everybody's Health,* and we believe it to be one of the most readable and attractive contributions to the subject that we have ever seen. It consists of thirty-two pages, with about a hundred illustrations, and it is all presented in a most vivid and understandable manner and cannot possibly fail of comprehension by the most unlearned observer. The phraseology is so simplified and so free from scientific terms that any mother will delight in reading the booklet, and the pictures portray so perfectly the ideas set forth that both mother and child will not only be attracted by it but will also follow the whole story with intense interest and undoubted benefit.

Of all the many laudable attempts to educate the public on the care of the teeth, we believe that Dr. Bundesen's contribution has solved the problem to a better purpose than has any previous effort of the kind that has ever come to our notice. He brings to his task not only a sympathetic interest in the welfare of children generally, but also a comprehensive grasp of the surest means of reaching the mothers and appealing to their cooperation in the most efficient rearing of their children.

The book is constructive in every way, and is not only exceedingly readable but also contains the essence of the most valuable information to be obtained on the subject.

MAKING GOOD

Making good in professional life represents many things. Aside from the periodic preachments on economics, we are taught that making good in dentistry consists in advancing the scientific and ethical aspects of our profession. These are paramount, of course—without science and without ethics, we would have small reason to call ouselves professional men or women; but there is something more than abstract science and concrete ethics involved in the job of making good.

In no profession of which we have knowledge is there so much demanded in the way of application and ability as there is in dentistry. The statement has frequently been made that there is a wider range of talent required to be a well-rounded dentist than to excel in any other calling, and while it may smack of provincialism for a dentist to advance such a theory, we still think that to make good in our profession calls for a peculiar order of talent and the fullest devotion to duty.

During the recent extended period of depression, we have seen too many men in the prime of life who have practically failed in dentistry, even to the extent of being obliged to abandon the profession, and it should give us pause and make us wonder why it is. In a broad sense, it may truthfully be said that a living can be made in dentistry if it can be made in any calling. This is so generally accepted that it has become almost axiomatic, and we have been in the habit of saying that while great fortunes were seldom or never made in the practice of dentistry, at least the profession might be counted on to furnish a respectable livelihood.

Of late, this has not always held good, and so many instances have come to light in contravention of this idea that it would seem necessary to analyze the reasons. Most of the cases of complete failure have been confined to practices in the big cities. This is only natural owing to the exactions of the city in the way of overhead expense and general high pressure whereby men are more or less ruthlessly crushed in the stampede of congested humanity. Then again, the prolonged industrial *impasse* has doubtless forced some men to the wall who otherwise would have survived.

Granted all of these exigencies, there remains the fundamental fact that, in the vast majority of cases of failure, the reasons may unerringly be traced to a single source, and there should be no blinking at this conclusion. The simple truth is that the cause will be found to lead in a direct line to the individual himself. In other words, to put it bluntly, if a man fails, it is his own fault. This of course excludes the exigency of illness or unavoidable incapacity.

In every single instance of failure, an acute observer will have no difficulty in deciphering the handwriting on the wall, which, when properly interpreted, is so plain that even he who runs may read. The man simply has not made good. Yet invariably he lays the blame at some other door—the times, the town, the profession or a hundred and one others. If he sought within instead of without, he would come more surely to the solution of his difficulty.

Times without number, the statement has been made that to make good in dentistry a man must be a gentleman, he must be cleanly, he must be skilful, he must be honest. So many attributes are essential for the successful practice of dentistry through long years of service that to enumerate them would be captious and well nigh banal. They have been proclaimed almost from the housetops, and drummed into our literature, yet there are two essentials that are seldom mentioned in this connection that mean more in making good than almost anything else. A man may be versed in the science and art of dentistry, he may be "well read," he may have technical skill, he may be gentle in his manipulations, yet if he lacks tact and judgment in handling people, if he has little or no personality, he is at once handicapped in winning and holding patients, and he will not long maintain a full and desirable practice. The manner of approach of some dentists is generally sufficient to proclaim their utter unfitness for contacts of a professional character. They do not fit in any stratum of society, they make no appeal to either the cultured or the uncultured, they have no magnetic hold on humanity and they are failures in spite of all the attributes that otherwise might prove an asset in winning confidence and making good.

Another thing, and one seldom considered or mentioned: the rockribbed exaction of invariably giving full value in service for

every dollar paid by the patient is one of the chief essentials in making good. To charge a fee that is out of all proportion to the service rendered is not only unethical, but also will be found to be economically disastrous. This has little or no relation to the abstract and much discussed question of high fees or low fees. A man may ethically and equitably establish a high fee schedule, and he may succeed in maintaining it provided he invariably renders commensurate service; but he will inevitably fail if he attempts to charge high fees for indifferent service. Many a man has foundered on this rock, and we are not sure that some of the failures of the recent past may not be traced to ineptitude of this character. A full day's work for a fair day's pay is as applicable to the practice of a profession as it is to equity in industry, and it is failure to observe this principle in both cases that has brought many of our professional men and many of our industrial workers to grief. Making good is a fundamental necessity in all walks of life, a fact that must more generally be recognized if we are ever to pull ourselves out of the social and economic mire, and proceed with certainty toward the regeneration of society or even of the world at large.

THE CASE FOR BRIDGEWORK

On various occasions, without any good reason, we are regaled with intemperate condemnation of bridgework, particularly fixed bridgework. Just why this kind of device is singled out for pointed and periodic criticism, it is difficult to determine, because, forsooth, every kind of artificial device is subject to limitations at times—bridgework not more so than the others. Considering all of the manifest abuses of bridgework and the ill-advised uses to which it has been subjected, the wonder is that it has been as successful as it has. Employed with discriminating care, and under proper conditions, bridgework is the most satisfactory of all means for the replacement of a few missing teeth. It is usually more acceptable to the patient than any form of removable appliance, and this is said with a full realization of the very ingenious and altogether

remarkable methods of restoration that have been devised in the way of partial denture construction. Never in the entire realm of human ingenuity has there been anything to exceed the perfection of technic of some of these removable partial dentures, and it is a tribute to dentistry to contemplate the wonderful work that some of our practitioners are doing in this direction. In cases wherein the natural teeth are sound on either side of a vacant space, there can be no question of the propriety of employing removable dentures instead of fixed bridgework. The cases are very rare in which it is justifiable to cut into a sound tooth for purposes of anchorage in the desire to construct a fixed bridge.

In no phase of our service to the patient is there greater need for discrimination in the selection of methods than in those cases in which a few teeth have been extracted, leaving the remaining teeth firm and serviceable. At best, it is a choice of methods, always with a limitation, for the reason that no kind of artificial substitute can ever wholly take the place of the natural organs. The nearest approach to it is through the medium of fixed bridgework properly constructed, and under suitable conditions. The patient is less conscious of artificiality in the use of bridgework than with any other system of replacement, and as for permanence, if the matter were capable of being checked, we doubt that bridgework would be found wanting.

The fact that the employment of fixed bridgework has proved disastrous in certain cases is no indication that the principle is at fault, or that the method should be discountenanced. It merely means that poor judgment has been used in the selection of cases, or that faulty technic has been employed. When cases are noted repeatedly wherein bridges have done satisfactory service for ten and even twenty years, and when at least one case of extensive bridgework has been known to last for more than a quarter of a century without giving the slightest trouble, there can no longer be any contention that bridgework is necessarily or generally temporary in character.

It sometimes becomes quite the fashion for men who have a special predilection for certain methods or policies to decry other

methods, without sufficient justification, but bridgework has been too long in the field and has given too long a tenure of satisfactory service to brush it aside without discrimination and relegate it to the scrapheap of oblivion. At least, a verdict of banishment should not be passed without a statement of the case for rebuttal.

THAT ANTERIOR FILLING

In a recent meeting of dental educators, a teacher of operative dentistry seized an open moment to ask, "What are the schools doing with gold foil?" The question was voiced significantly. To lay ears, there was a tang of assault in it. A sort of "Who is on the Lord's side?" quality. An ideal was waning. It must be revived. Who here is recreant in the matter of gold foil? The answers given were in keeping with the question in tonal quality. They sounded defensive; the insistence on integrity was a trifle obvious. Likewise—or so it appeared—the insistence lacked enthusiasm. In what seemed a weak exhortation, one teacher said: "The instruction is at fault. Students reflect their teachers in after life. A great mathematician produces life-long devotees to figures. The same would be true of gold foil operators." Silence. And then a reply that patients did not want it fell without effect or response, and the episode was over.

Gold foil was not eulogized by the man who asked the question. It is the best filling known to dentistry and everybody knew it. Its shortcomings they knew, its color and the difficulty of placement. It was taken for granted that all dentists would accede to its virtues, even those who never place foil fillings. And there are many. Conscious of this fact, the teachers struggled to maintain sufficient hours in the curriculum for student practice. But there was an obvious rift in the lute, a pulling against the stream effect, an apathy that marks the defense of a losing or lost cause. Patients don't want it.

But what has a patient to say in the diagnosis? Who directs the affairs in a dental office? What dentist deserving the name will be

deflected from conscientious duty by a patient's whims? "A gold filling is indicated here. It will last—and so on." "But, doctor," comes the reply, "I don't want it. All you say may be true—." If the discussion progresses to the way the gold is to be placed, the patient gathers strength for opposition. The looks factor in the early reaches of life forms the basis of biologic appeal and opportunity. That element cuts both ways. To a patient, it is—unconsciously may be—final; to the operator, it transcends worth and durability. At least, it should. The operation has no dire results—at least, not now—and by the time replacement may be necessary, conditions may have changed. Is the gold filling placed?

Some interesting facts stand disclosed. The patient may have the last word in the dental chair, teachers to the contrary if must be. Men in practice do not drive income out the door by armored resistence when the issue is not more decisive than this. Often the dentist—who has not experienced it?—places constructions he knows are not wise because the patient refuses his advice. He does it with hope and fear—hope that what he does will serve a reasonable time, and fear that, should it not, the patient will forget his advice. The patient usually forgets. Despite the theory of the dentist's dominance at the chair, despite protestations made among his peers in educational conclave or otherwhere, the patient is a potent determinant in many dental procedures, and in this one in particular.

Gold for anterior teeth is unwanted whether hammered or cast. We all know the objections. No persuasion will elicit a willing consent to its use in a large percentage of cases. Coercion on any basis is out of the question; the result is too far reaching. What is left?

The porcelain inlay cannot be considered. Objections to it need no reiteration. We end with the plastic synthetic preparation as was suspected from the beginning. Writing becomes difficult here. The room fills with murmurs in spite of its emptiness. But the argument goes on. We know all the objections available against them, but they will not be listed here. The fact that stares at us makes us dare and challenge. Something must be done. Are all

the resources of nature and scholarship expended? Are the objections to perfectly matched filling materials insuperable? Are our chemistry departments unequal to the problems presented?

See what is being done to make dentures simulate tissue in color and life-likeness. Perfection has not been reached yet, nor has endeavor ended. Who dares say it won't be attained? Similarly must the desired filling be attained. There is no great thrill in vociferating against a rising tide nor in reproaching a receding one. Gold foil has been, is, and always will be a good filling substance. The object of dentistry must be to get a better. What are operating departments doing to produce one—other than to dogmatize for gold? T.

THE CARIES CHAOS

Under the caption "The Caries Chaos," an English dentist presents a humorous portrayal of the status quo of dentistry and its major problem. An abstract of it appears in this issue of THE JOURNAL. The gentleness of the humor that pervades the essay is disarming and the self-inclusiveness of it would dissuade the most belligerent from counterattack. It contains no boisterous laughter, but, what is much better, it simmers with quiet mirth. It marks the Editor's first observation of scholarship wreathed in smiles in dental literature—for the man is a scholar—and it catches an American's fancy that such a thing could occur in an English journal, the work of an Englishman. The thought recurs: "How does he dare?" Read it! T.

COUNCIL ON DENTAL THERAPEUTICS

SQUIBB DENTAL CREAM
Omitted from
ACCEPTED DENTAL REMEDIES

The acceptance of Squibb Dental Cream was announced in the October, 1931, issue of THE JOURNAL. The product was admitted to Accepted Dental Remedies after the firm had agreed to revise their advertising to comply with the Council's provisions for dentifrices.

In spite of the agreement to confine its advertising statements to the provisions of the Council for dentifrices, during the course of the year for which the product was accepted, the firm advertised in lay and professional publications therapeutic claims which were in conflict with the Council's provisions for dentifrices.

Because E. R. Squibb & Sons advertise Squibb Dental Cream to the public and to the profession with therapeutic claims in conflict with the liberal provisions of the Council for dentifrices, it is being omitted from Accepted Dental Remedies.

The Council stands ready to consider Squibb Dental Cream for readmission to Accepted Dental Remedies when the firm assures the Council by revising its advertising policy that it is ready to abide by the reasonable provisions of the Council for dentifrices.

SAMUEL M. GORDON, *Secretary*

PEBECO TOOTH PASTE
Omitted from
ACCEPTED DENTAL REMEDIES

The acceptance of Pebeco Tooth Paste was announced in the October, 1931, issue of THE JOURNAL. The product was admitted to Accepted Dental Remedies after the firm had agreed to revise their advertising to comply with the Council's provisions for dentifrices, and also on the condition that the firm would undertake experiments looking toward the omission of potassium chlorate, or to reducing it in content.

While the product was still being considered for possible reacceptance in the latter part of 1932, the Council was informed that the company would undertake a revised advertising program for this product in 1933. The advertising which followed this communication was a reversion to a type of advertising which the firm had agreed to give up when the Council first considered the product.

Because Lehn & Fink, Inc., are advertising Pebeco Tooth Paste to the public with claims that conflict with the extremely liberal provisions of the Council for dentifrices, it is being omitted from Accepted Dental Remedies.

SAMUEL M. GORDON, *Secretary*

ACCEPTED DENTAL REMEDIES

The following is a continuation of Accepted Dental Remedies. The Council will appreciate constructive criticism which will aid in future revisions of the material.

SAMUEL M. GORDON, *Secretary.*

ESSENTIAL OIL AND RELATED PRODUCTS

An essential oil is a volatile, nongreasy, nonsaponifying oil, of a characteristic odor, obtained from plants or from plant constituents by pressure, or by maceration. A characteristic distinguishing this class of oils from the fixed or fatty oils is their volatility and solubility in alcohol.

Chemically, essential oils vary from simple to complex mixtures which are often difficult to separate. The characteristic therapeutic properties of the oils are due in large measure to the presence of one or more well defined compounds. Some oils are readily separated into their important constituents by simple means, thus yielding more or less pure compounds, useful in therapeutics. Some of these are cineol (eucalyptol), menthol, thymol and eugenol.

In dentistry, essential oils are chiefly used for their antiseptic, obtunding and stimulating properties. They have been added to drugs with escharotic properties on the assumption that they reduce such effect and aid in the "stimulation" and "growth" of new tissue, but this has not been adequately determined. Some of the oils, such as oil of cloves, are used temporarily to relieve pain, as in toothache; the effect of this anodyne being due possibly to depression of the exposed nerve terminals, or to counterirritation.

Essential oils possess characteristic odors and taste. They are used to flavor dentifrices and mouth washes. In these preparations, the concentration of the volatile oil is too low to exert any therapeutic effect. Internally, they act as carminatives. They are also used to disguise substances of less agreeable taste.

OIL OF CLOVES, U.S.P.—(Clove Oil, Oil of Cloves)—Oleum Caryophilli (Ol. Caryoph.)—A volatile oil distilled from cloves; assayed to contain 82 per cent of eugenol.

Properties: Oil of clove occurs as a colorless or pale yellow liquid, becoming darker and thicker by ageing and exposure. It is freely soluble in alcohol, but nearly insoluble in water.

Actions and Uses: Oil of cloves is antiseptic and aromatic. It is frequently used as a carminative, and rarely externally as counterirritant. In dental practice, it is used as an anodyne. Some clinicians have found that eugenol is more satisfactory than oil of cloves. The cavity must be dry for the drug to have any effect, because it is almost insoluble in water. Combined or mixed with zinc oxide into a paste, it is used for covering or capping an exposed dental pulp. It and eugenol are used for reducing ammoniacal silver nitrate to metallic silver in dentin.

Dosage: To relieve toothache, oil of cloves should be dropped on a minute piece of cotton and placed without pressure in the cavity of the carious tooth. For external use, it is diluted with 2 or 3 parts of fatty oil.

OIL OF ANISE, U.S.P.—(Anise Oil). Oleum Anisi (Ol. Anisi). A volatile oil from anise. Very slightly soluble in water; very soluble in alcohol.

Actions and Uses: Aromatic carminative and flavor. It is used as a flavoring agent, and to disguise other substances of less agreeable taste.

Aqua Anisi (Aq. Anisi.) Anise Water, U.S.P.: A solution of anise in water. May be used as a spray solution after operative intervention.

OIL OF ORANGE, U.S.P.—(Oleum Aurantii Corticis, U.S.P. VIII. Orange Oil, Oil of Sweet Orange.) Oleum Aurantii, (Ol. Aurant).—A volatile oil. Nearly soluble in water; soluble in alcohol and ether.

Uses: As a flavoring agent.

EUGENOL, U.S.P.—A phenol $C_6H_3.C_3H_5.OCH_3.OH$ 1:3:4 obtained from clove and other sources.

Properties: Eugenol occurs as a colorless or pale yellow liquid possessing an odor of cloves and a pungent spicy taste. It is slightly soluble in water, and miscible with alcohol, chloroform and ether.

Actions and Uses: Eugenol represents the essential chemical constituent of oil of cloves. The action of oil of cloves is due principally to the eugenol content. In its uses it is, therefore, similar to oil of cloves. A solution in olive oil mixed with a mixture of resin and zinc oxide is used as a protective pack after excision of gum tissues (see "Zinc Oxide").

OIL OF CINNAMON, U.S.P.—(Oleum Cassiae, U.S.P. X, Cassia Oil) Oleum Cinnamoni. (Ol. Cinnam.).—A volatile oil distilled from cinnamomum cassia, assayed to contain not less than 80 per cent of cinnamic aldehyde. It occurs as a yellowish liquid having the characteristic odor of cinnamon and a sweetish, spicy and burning taste. It is very soluble in alcohol, very slightly soluble in water.

Actions and Uses: In dentistry, it is used primarily as a flavoring agent and as a very mild antiseptic. A solution in water (cinnamon water) may be used as a spray after an operative procedure. It is a constituent of Black's 1:2:3 mixture: 1 part oil of cinnamon, 2 parts oil of wintergreen, and 3 parts phenol (which see).

Cinnamon Water, U.S.P.: Aqua Cinnamomi (Aq. Cinnam.)—A saturated solution of oil of cinnamon in distilled water.

OIL OF EUCALYPTUS, U.S.P.—(Eucalyptus Oil) Oleum Eucalypti (Ol. Eucalypt.)—A volatile oil distilled from the fresh leaves of eucalyptus globulus and other species of eucalyptus; assayed to contain not less than 70 per cent of eucalyptol (cineol).

Properties: Oil of eucalyptus occurs as a colorless or pale yellow liquid, having a somewhat camphoraceous odor, and a pungent, spicy and cooling taste. It is miscible in all proportions with alcohol, but it is practically insoluble in water.

Actions and Uses: Eucalyptol and oil of eucalyptus both possess antiseptic and expectorant properties. But it is pointed out that as an antiseptic it is practically valueless. Used on cotton, it is useful for treatment of root canals during observation. Eucalyptol (cineol) appears to be more widely used than the oil of eucalyptus. It is used as a solvent of guttapercha.

Preparations containing eucalyptol exert a rather long continued irritant action, and thus tend to retard rather than promote healing.

OIL OF PEPPERMINT, U.S.P.—Oleum Menthae Piperitae (Ol. Menth. Pip.).—A volatile oil distilled from the flowering plant of mentha piperita; assayed to contain not less than 5 per cent of menthyl esters and not less than 50 per cent of total menthol.

Properties: Oil of peppermint occurs as a colorless liquid with the characteristic peppermint odor and a strongly aromatic, pungent taste, followed by a sensation of cold when air is drawn into the mouth, apparently due to a peculiar sensory nerve stimulation.

Actions and Uses: The therapeutic properties depend primarily on the menthol present. A solution of oil of peppermint in alcohol, glycerine and water has been suggested as a fluid to be used in massaging the gums. In this connection, it has no therapeutic effect. On account of its odor, it is not used as an antiseptic, but is commonly used as a flavoring agent of dentifrices, mouth washes, etc.

Peppermint Water, U.S.P.: Aqua Menthae Piperitae (Aq. Menth. Pip.).—A saturated solution of peppermint in distilled water.

MENTHOL, U.S.P.—Menthol, $C_{10}H_{19}OH$.—A secondary alcohol obtained from oil of peppermint or other mint oils.

Properties: Menthol occurs as colorless, acicular or prismatic crystals, having a strong

and pure odor of peppermint and a warm, aromatic taste, followed by a sensation of cold when air is drawn into the mouth. It is only slightly soluble in water, but freely soluble in alcohol, ether and in liquid petrolatum.

Actions and Uses: Solid menthol is used in the form of "menthol pencils" as a cooling counterirritant, especially in neuralgia or headache, being frequently rubbed over the painful area. As a counterirritant for inflamed mucous membranes, especially in the nose and throat, menthol is used in 1 per cent solution in liquid petrolatum.

Menthol has been combined with various phenols and resins for the treatment of pulp canals. It is probable that menthol merely dilutes the more active agent. A mixture of resin (French violin box), 15 parts by weight; thymol, 4 parts by weight; phenol, 2 parts by weight, and menthol, 1 part by weight, has been used in the treatment of pulp canals.

OIL OF SPEARMINT, U.S.P.—(Spearmint Oil). Oleum Menthae Viridis (Ol. Menth. Vir.).—A volatile oil. Nearly insoluble in water, soluble in alcohol.

Actions and Uses: Aromatic carminative and flavoring agent.

Spearmint Water, U.S.P.: Aqua Menthae Viridis (Aq. Menth. Vir.). A saturated solution of oil of spearmint in distilled water.

OIL OF WINTERGREEN, U.S.P.—Methylis Salicylas (Methyl. Salicyl.).—Methyl Salicylate (Oil of Gualtheria, Oil of Betula, Oil of Sweet Birch, Oil of Teaberry). $C_6H_4(OH)CO_2CH_3$.

Methyl salicylate is produced synthetically or is obtained by distillation from the leaves of Gualtheria procumbens or from the bark of Betula lenta.

Properties: Methyl salicylate is a colorless, yellowish or reddish liquid, having the characteristic odor and taste of gualtheria. It is slightly soluble in water, but is miscible with alcohol and with glacial acetic acid. It is soluble in about 7 volumes of 70 per cent alcohol at 25 C. with not more than a slight cloudiness.

Actions and Uses: Methyl salicylate is antiseptic. When rubbed on skin it is absorbed, producing at the same time, mild irritation. For the relief of pain in local rheumatic swellings and neuritis, it is frequently applied as a counterirritant. It is widely used as a flavoring agent.

It is useful in the treatment of teeth which are erupting with difficulty. Combined with lanolin, it may be rubbed sparingly on the face over the area involved. It is a constituent of Black's 1:2:3 mixture.

THYMOL, U.S.P.—Thymol, $(C_6H_3(CH_3)(OH)C_3H_7)$, 1:3:4.—A phenol occuring in the volatile oil of Thymus vulgaris and in some other volatile oils.

Properties: Thymol occurs as large, colorless prisms, having an aromatic thyme-like odor, and a pungent aromatic taste. It is only very slightly soluble in water (1:1,000), but freely soluble in alcohol (1:1).

Actions and Uses: The actions of thymol are similar to those of phenol. Its antiseptic efficiency is higher, restraining the growth of pus organisms in 1:3,000. It is not an active germicide. It also possesses fungicidal and vermicidal actions.

Thymol has a rather pleasant, clean taste and a saturated aqueous solution makes a rather agreeable and fairly efficient mouth wash or gargle. In combination with phenol and camphor, it has been used for acute pericementitis.

For use in filling pulp canals, a 1 to 5 per cent solution in chloroform is made, and in this is dissolved sufficient violin bow resin to make a ten per cent solution; that is, 1 gm. of thymol and 9 gm. of resin in 100 c.c. of chloroform.

A mixture of equal parts of thymol and cresol, mixed with zinc oxide to make a stiff paste, has been suggested for pulp mummification. It is used in capping pulps by melting over the exposed pulp, alone or in combination with zinc oxide.

Fibrin Ferments and Thromboplastic Substances

Thromboplastic substances and fibrin ferments were introduced into medicine about fifteen years ago as aids in hastening the coagulation of blood. Preparations of this nature were introduced for local and intravenous use. In the meantime, evidence has been accumulating that their intravenous use almost always presents grave danger; nor is there

satisfactory evidence that they are effective when introduced subcutaneously. It seems improbable that when used in this way they are of any value in controlling hemorrhage. It is possible that local application may be of some value. (In this connection, the Council desires to point out that intravenous medication is in general fraught with many dangers. These dangers, anaphylaxis, shock, etc., are too great to compensate for the claimed advantages of this type of drug administration. Since intravenous injection of drugs disturbs a delicately balanced physiologic equilibrium, the Council suggests that this type of medication be resorted to only in cases of the gravest emergency, such as shock arising from certain anesthetic actions, and that it be used only when other measures have absolutely failed.)

The clotting of blood may be regarded as the transformation of the fibrinogen of the circulating blood into the insoluble protein material, fibrin, of the blood clot. Different views regarding this phenomenon have been advanced from time to time. It is generally agreed that the clotting of blood is due to the action of thrombin (the fibrin ferment) on the fibrinogen of the blood.

Thrombin exists in the blood not as such but as prothrombin (the precursor of thrombin), which, when acted on by the calcium salts of the blood, is converted into the active agent, thrombin. (This explains why oxalated blood does not clot; a fact of importance in blood chemistry.) Other factors in addition to calcium salts are necessary for clotting, since normal blood contains a sufficient amount of calcium salts, yet spontaneous clotting does not occur in the blood vessels, except in certain pathologic conditions (thrombosis, etc.)

This other factor has been designated as "zymoplastic substance" by Schmidt, as "thrombokinase" by Morowitz, and as "thromboplastic substance" by Howell, who holds that blood does not coagulate in the vessels, since prothrombin exists there in combination with an inhibiting substance which prevents it from acting. He believes that when blood is shed or flows over injured tissues, the thromboplastin derived from the blood cells, platelets or tissue cells, reacts in some undetermined manner with the inhibitor, liberating prothrombin from combination with the inhibiting agent. The liberated prothrombin activated by the calcium salts converts the fibrinogen into fibrin, and initiates clotting.

Howell has shown that thromboplastin or "thromboplastin substance" from every source which he has investigated contains the phospholipid cephalin (see any standard textbook on physiologic chemistry) and that the accessory action of thromboplastin in coagulation is due to the action of cephalin.

Cephalin (or kephalin) is soluble in ether, but insoluble in acetone or alcohol. In a solution or in solid form, cephalin gradually loses its power to hasten clotting of blood, owing, probably, to an oxidation of the unsaturated fatty acids in the molecule. Because of this deterioration, only those products which bear a date of labeling should be used.

Actions and Uses: Preparations containing thromboplastin are said to be useful when applied locally in the treatment of hemorrhage, especially hemorrhages from local surfaces and specifically after the extraction of teeth. It is also said to be useful in the treatment of scar tissues, in nose bleed and in surgery. It is reported that many surgeons are abandoning its use. It may well be questioned whether simple mechanical means do not in most cases bring about a desired clotting action.

The intravenous administration is dangerous, and the subcutaneous administration is irrational, as there is no satisfactory evidence that such administration is useful.

Preparations should be standardized by testing on specimens of blood *in vitro*. Acceptable preparations should be able to reduce the coagulation period to about one third of the original time; and they should be proved sterile.

In view of their acceptance by clinical dentists for local administration, the Council will accept thromboplastic preparations for inclusion in A. D. R. provided they are marketed with claims limited to their local application.

FIBROGEN LOCAL-MERRELL.—Suspension of fibrinogen and cephalin for local use. A sterile suspension of tissue fibrinogen and cephalin, containing 1.5 per cent of tissue fibrinogen and 0.5 per cent of cephalin in a solution of sodium chloride 0.9 per cent.

Action and Uses.—See "Fibrin Ferments and Thromboplastic Substances."

Dosage: Fibrogen Local-Merrell is applied locally, undiluted.

Manufactured by the Wm. S. Merrell Company, Cincinnati. U. S. patent Re. 16,639, U. S. trademark 208,383.

Fibrogen Local-Merrell, 7 c.c. vials.

Fresh beef lungs are finely ground and extracted with 1 per cent sodium chloride solution. To the filtered extract is added an equal volume of saturated ammonium sulphate solution. The globulin fraction which contains the tissue fibrinogen is precipitated and removed by filtration. A 1.5 per cent aqueous suspension of the globulin is made and sterilized by the addition of mercuric chloride. The mercury is removed by dialysis. The sodium chloride content is adjusted to make a concentration of 0.9 per cent. Cephalin, which acts as a stabilizer against loss of activity by heat, is added to the extent of 0.5 per cent. Cresol, added to maintain sterility after the container is opened, is in such proportion that the finished product contains 0.3 per cent. Bacteriologic tests are carried out to insure absolute sterility. The potency of fibrogen local-Merrell is determined by its ability to coagulate recalcified citrated or oxalated plasma and whole blood. When tested by the oxalated plasma method, the clotting time is reduced 85 per cent or more. The clotting power of fibrogen local-Merrell is also regularly tested on fresh whole blood, as follows: Withdraw 10 c.c. of blood from the heart of a rabbit, into an oiled syringe. Transfer 1 c.c. into each of six test tubes, warmed to 37.5 C. in a constant temperature water bath. Add to each of three tubes which are to serve as controls 0.1 c.c. of physiologic solution of sodium chloride and mix; then to each of the remaining tubes, an equal amount of fibrogen local-Merrell, and mix likewise. The blood in those tubes containing fibrogen local-Merrell shall have solidly clotted within from fifteen to forty-five seconds; whereas, the control blood will clot after from fifteen to twenty-five minutes. The clotting time is thus reduced approximately 90 per cent. The amount of residual mercury after dialysis is determined by the electrolytic method. The amount of mercury present after dialysis is less than 1 part of mercury to 15,000 parts of fibrogen local-Merrell.

THROMBOPLASTIN LOCAL—SQUIBB.—An extract of cattle brain in physiologic solution of sodium chloride prepared according to the method of Hess. It complies with the product solution brain extract in physiologic solution of sodium chloride prepared by the method of Hess (*J. A. M. A.*, 66:558 [Feb. 19] 1916, Footnote 2).

Actions and Uses: Thromboplastin-Squibb, like other fibrin preparations, is useful when applied locally in the treatment of hemorrhages particularly on the oozing surfaces and in hemorrhage following extraction of teeth. It is applied by means of sterile tampons saturated with thromboplastin. (See foregoing paragraphs, "Fibrin Ferments and Thromboplastic Substances.")

Dosage: Thromboplastin Local-Squibb is applied locally undiluted.

Thromboplastin-Squibb is marketed in 20 c.c. vials. It is claimed that no loss of potency could be detected in unopened thromboplastin-Squibb more than three years old.

Manufactured by E. R. Squibb and Sons, New York City. No U. S. patent or trademark.

Blood plasma is obtained by bleeding 45 c.c. of sheep's blood into a tube containing 5 c.c. of 1 per cent sodium oxalate in physiologic solution of sodium chloride, centrifuging the mixture to obtain the clear plasma and preserving this at a low temperature. A 0.5 per cent calcium chloride solution is prepared by dissolving 0.5 gm. anhydrous calcium chloride in 100 c.c. of physiologic solution of sodium chloride. Place 5 drops of blood plasma in a flat bottomed vial, add 3 drops of calcium chloride solution and 2 drops of the thromboplastin-Squibb to be tested and mix the contents by gentle rotation. Not more than sixty seconds should elapse before the vial may be completely inverted without loss of its contents.

FIXED AND MINERAL OILS

Fixed oils and fats are neutral esters of vegetable or animal derivation, being compounds of acids (chiefly oleic, palmitic and stearic) with glycerine. Mineral oils are derived from petroleum by distillation, chilling and purification by filtration through bone black. They consist of hydrocarbons of the methane and related series. They are similar to the fats in therapeutic application. They are chemically indifferent, and do not undergo deterioration or become rancid.

CASTOR OIL, U.S.P.—Oleum Ricini (Ol. Ricin.)—A fixed oil expressed from the seed of Ricinus communis.

Properties: Castor oil occurs as a pale yellowish or almost colorless viscid liquid, having a faint, mild odor and a bland, afterward slightly acrid and usually nauseating taste. It is insoluble in water, but freely soluble in alcohol (1: 1).

Actions and Uses: Castor oil is used as an active cathartic, irritating mildly both the small and the large intestine. It is sometimes employed as a demulcent, particularly in the eye.

Dosage: 15 c.c. (4 fluidrachms) castor oil may be administered to adults in the form of elastic capsules (up to 5 c.c. in each), in lemon or grape juice, or in the form of "soda water." To children, it may be given in the form of emulsion, Emulsion Olei Ricini, N.F., which contains 35 per cent of castor oil.

LANOLIN, U.S.P.—Adeps Lanae Hydrosus (Adeps Lan. Hyd.) Hydrous Wool Fat.—It is made by incorporating the purified fat of sheep's wool with not less than 25 per cent, nor more than 30 per cent, of water.

Hydrous wool fat is used as an ointment base. It does not become rancid, and as much as twice its weight of water can be incorporated with it. It has a somewhat unpleasant odor. It requires dilution for use in ointments, and from 20 to 100 per cent of petrolatum may be added for this purpose. It does not appear to be absorbed more readily than other ointment bases.

OLIVE OIL, U.S.P.—Oleum Olivae (Ol. Oliv.)—A fixed oil.

Properties: Olive oil occurs as a pale yellow or light greenish yellow oily liquid, having a slight, peculiar odor and taste, with a faintly acrid after-taste. It is slightly soluble in alcohol, and is miscible with chloroform, ether and most essential oils.

Actions and Uses: In addition to its uses as an emollient, laxative and nutrient, it is used in the preparation of the so-called zinc oxide packs. It is claimed to retard the setting time of cement, but other less expensive fixed oils can be used for this purpose.

PETROLATUM, U.S.P.—Petrolatum (Petrolat.) (Amber Petrolatum, Petroleum Jelly).—A purified, semisolid mixture of hydrocarbons, obtained from petroleum.

PETROLATUM ALBUM.—(Petrolat. Alb.)—White Petrolatum, U.S.P. (White Petroleum Jelly).—Petrolatum wholly or nearly decolorized.

Properties: Petrolatum occurs as an unctuous mass, of about the consistency of ointment, varying in color from white to dark amber.

Actions and Uses: Petrolatum and white petrolatum are used chiefly as bases for ointments. Sterilized petrolatum is employed as a lubricant and as an emollient and protective.

LIQUID PETROLATUM, U.S.P.—Petrolatum Liquidum (Petrolat. Liq.)—A mixture of liquid hydrocarbons, obtained from petroleum. The specific gravity ranges from 0.828 to 0.905. Two varieties are separately described in the Pharmacopoeia as:

Heavy Liquid Petrolatum: Kinematic viscosity not less than 0.381 at 37.8 C.

Light Liquid Petrolatum: Kinematic viscosity not more than 0.370 at 37.8 C. It is suitable for use in atomizers.

Properties: Liquid petrolatum occurs as a colorless or very slightly yellowish, oily, transparent liquid, without odor or taste, but giving off, when heated, a faint odor of petroleum. It is insoluble in water and in alcohol.

Actions and Uses: Liquid petrolatum is used as a vehicle for medicinal agents for local application. Light liquid petrolatum is employed for sprays. Heavy liquid petrolatum is given internally, largely for its mechanical action to keep the stools soft in the treatment of constipation. It is not absorbed by the intestine and has no nutritive value.

Light liquid petrolatum, after immersion and heating to 185 C. for five minutes, is said to effectively sterilize the dental handpiece against *B. anthracis.* (Appleton, J. L., Jr.: Sterilization of Handpiece, *D. Cosmos,* 66:861 [Aug.] 1924).

Liquid petrolatum is used in compounding a zinc oxide-resin pack for pyorrhea surgery. (Crane, A. B., and Kaplan, Harry: Crane-Kaplan Operation for Prompt Elimination of Pyorrhea Alveolaris, *D. Cosmos,* 73:643 [July] 1931).

Formaldehyde Preparations and Compounds Which Liberate Formaldehyde

The antiseptic action of formaldehyde cannot be utilized directly on the body because of the irritating and coagulant effects. Attempts have been made to avoid these effects by combining the formaldehyde in such a way as to cause it to be liberated from the compound very gradually. The results have been rather disappointing, because it is difficult, if not impossible, to secure just that degree of stability in a compound from which the formaldehyde will be liberated in concentration sufficient to maintain the antiseptic action, but not sufficient to become irritant. Methenamine (hexamethylenetetramine) is a notable exception; but its effects are confined to acid fluids, and, therefore, essentially to the urine. Other compounds are effective mainly through the other constituents with which the formaldehyde is combined, rather than through the formaldehyde itself.

The wide reactivity of formaldehyde gives the possibility of a great variety of compounds; with proteins; carbohydrates; amides, phenols and aromatic derivatives. Methena-

mine does not contain formaldehyde as such, but liberates it under acid conditions. Because the reaction of the saliva is slightly alkaline or near the neutral point, the use of methenamine in mouth preparations is irrational and ill advised.

Formaldehyde, even in dilute solutions, is irritating and its continuous use in mouth washes is stated to cause sloughing of soft tissues. The susceptibility is diminished with continued use.

It is effective for the sterilization of instruments in a 1.5 to 5 per cent solution.

Formaldehyde formerly was much used for disinfecting purposes after contagious diseases, but this practice is no longer prevalent.

FORMALDEHYDE.—Formaldehyde, CH_2O.—Formaldehyde is a gas commonly obtained by oxidation of methyl alcohol. It is used in medicine in the form of a solution.

SOLUTION OF FORMALDEHYDE, U.S.P.—Liquor Formaldehydi (Liq. Formaldehyd.).—An aqueous solution containing not less than 37 per cent of formaldehyde (CH_2O) and varying amounts of methyl and ethyl alcohol, or both. It is very often referred to in the literature by the proprietary name, formalin.

Properties: Solution of formaldehyde is a clear, colorless liquid, having a pungent odor and caustic taste. It is miscible in all proportions with water and alcohol. On standing, it sometimes loses its transparency, owing to the separation of paraformaldehyde, a polymerization product of formaldehyde. Paraformaldehyde is also frequently formed on evaporation of the solution. Paraformaldehyde is a solid which is in large part changed again into formaldehyde on heating.

Incompatibilities: Solution of formaldehyde is incompatible with oxidizing agents and with alkalis. With ammonia, it forms methenamine (hexmethylenamine).

Actions and Uses: Formaldehyde is a powerful germicide, especially valuable in the form of gas because of its penetrating power, but it is active only in the presence of an abundant moisture. The solution is germicidal in the strength of from 1 to 2 per cent (percentages refer to amounts of absolute formaldehyde, HCHO), but the action may be delayed from twenty to thirty minutes. In the concentration of 1:5,000 it restrains the growth of many organisms, and, in many cases, a strength of 1:20,000 or 1:30,000 is sufficient to prevent the multiplication of bacteria. It hardens tissues and is used in histologic technic for this purpose. It has a similar hardening effect on the living skin. It is very irritating and produces reddening, inflammation and necrosis, if applied repeatedly or continuously, It is sometimes used with a solution of soap for the disinfection of hands. The use of formaldehyde for the preservation of food is condemned because of the disturbance of digestion which often follows its ingestion.

The commonest application of formaldehyde is in room disinfection.

Formaldehyde has been used in 10 per cent solution (liquor formaldehyde 1:3) for the reduction of ammoniacal silver nitrate in root canal work as part of Howe's ammoniacal silver nitrate treatment. In place of formaldehyde for reduction of ammoniacal silver nitrate many operators prefer eugenol as the reducing agent. The application of formaldehyde is restricted because of its powerful irritant properties. In combination with cresol, thymol and other phenols, it has been suggested for the treatment of pulp gangrene, and for the mummification of pulp stumps. It has powerful reducing properties and combines readily with protein and other types of organic matter. In combination with beechwood creosote, formaldehyde has a wide application in the treatment of infected pulp canals. Many clinicians feel it is unfortunate that such use has not been discontinued. Unless great precaution is observed in applying this solution, necrosis of the apical tissues will occur.

Formalin: A brand of solution of formaldehyde, U.S.P.

Schering & Glatz, Inc., Bloomfield, N. J., and New York, distributor. U. S. trademark 65,625.

FORMALDEHYDUM CRESOLATUM.—(Formal. Cresol.)—Cresolated Formaldehyde, N.F.—Consists of orthocresol (40 per cent) and solution of formaldehyde (60 per cent).

Actions and Uses: It has the germicidal activities of solution of formaldehyde and of orthocresol. A safer compound is said to be beechwood creosote, 90 per cent (colorless) and formaldehyde, 10 per cent.

PARAFORMALDEHYDE, U.S.P.—Paraformaldehyde, Paraformaldehydum—paraform—Trioxymethylene—$(HCHO)_3$. A polymer of formaldehyde.

Properties: Paraformaldehyde is a white powder, possessing a slight odor of formaldehyde. It is very slowly soluble in cold water, more rapidly soluble in hot water with formation of formaldehyde, insoluble in alcohol and ether and soluble in solution of fixed alkalis.

Actions and Uses: It is converted into formaldehyde by heat, and is therefore used in fumigation. As formaldehyde is also liberated in contact with water, paraformaldehyde is antiseptic and escharotic. It has been used in mummifying pastes.

As an example of the combination in which it has been used, the following recipe may be mentioned: paraform, 20 parts; beechwood creosote, 10 parts; glycerine, 4 parts; zinc oxide, 66 parts.

GLYCERINE, U.S.P.—Glycerinum (Glycerin.) (Glycerol) $C_3H_5(OH)_3$. A liquid obtained by the decomposition of vegetable or animal fats or fixed oils. It contains not less than 95 per cent of the trihydric alcohol ($C_3H_5[OH_3]$).

Properties: Glycerine occurs as a clear, colorless liquid, of a thick syrupy consistency, smooth to the touch, odorless or having not more than a slight, characteristic odor. It has a sweet taste and produces a sensation of warmth in the mouth. It is readily miscible with both water and alcohol.

Actions and Uses: Glycerine is used in dentistry as in medicine, chiefly as a solvent in preparing glycerites, and as a sweetening agent or vehicle in place of syrups, and as a vehicle for drugs used locally in or about the mouth. It serves as a protective for the skin and mucous membranes. It is also used as an evacuant in the form of rectal suppositories, and is widely used in the preparation of mouth washes. The claims made by proponents of tooth powder that the glycerine in tooth pastes is harmful have not been supported by acceptable evidence. (Reports of the Council: Glycerine in Tooth Pastes, *J.A.D.A.*, 19:509 [March] 1932.)

GLYCERITES.—These are solutions of medicinal substances in glycerine.

GLYCERITE OF TANNIC ACID, U.S.P.—(Glycerite of Tannin)—Glyceritum Acidi Tannici. (Glycer. Acid. Tan.).

GLYCERITE OF BOROGLYCERINE, U.S.P.—(Glycerite of Carbolic Acid.)—Glyceritum Phenolis (Glycer. Phenol.).

Hypochlorites and Hypochlorite Substances

The germicidal action of free chlorine and chlorine liberated from the hypochlorite mixtures is well known. In medical practice, it is employed in the form of chlorine water, chlorinated lime, solution of chlorinated soda (Labarraque's solution) and solution of chlorinated potassa (javelle water).

Hypochlorite preparations are fairly permanent in the presence of alkali, and alkaline hypochlorite preparations have the added advantage that the alkali has a destructive and solvent action on most bacteria and other organic matter. The treatment of infected wounds with hypochlorite solutions as carried out at present does not permit an excessive degree of alkalinity on the grounds that it causes destruction of normal tissue and irritation of the skin.

Organic preparations containing a chlorimide group which are practically neutral and relatively stable have been proposed as substitutes for hypochlorites on the theory that the action of hypochlorites is dependent on the combination of their active chlorine (Cl^+) with nitrogen of proteins.

CHLORINATED LIME, U.S.P.—(Bleaching powder, often improperly called "chloride of lime"). Calx. Chlorinata (Calx. Chlorin.)—A variable compound resulting from the action of chlorine on calcium hydroxide. It contains not less than 30 per cent of available chlorine, that is, chlorine which is set free by the action of an acid.

Properties: Chlorinated lime occurs as a white or grayish white granular powder, having a chlorine-like odor, and a repulsive saline taste. It is only partially soluble in water or alcohol.

Actions and Uses: Chlorinated lime is a disinfectant. A 5 per cent solution is suitable for ordinary use. It is used extensively as the source of chlorine for treating contaminated

drinking waters. The fresh solution of about 0.5 strength should be added to the water to be treated in the proportion of about 25 gallons per million gallons of water, the proportion varying with different waters.

Hypochlorites in acid, alkaline and nearly neutral solutions have been found useful in the treatment of infected wounds. Discolored teeth may be bleached by mixtures of chlorinated lime. One procedure in general is as follows:

Remove all metal fillings from the crown of the tooth, and sterilize and fill the pulp canals. Having the tooth to be treated (and best only the one tooth) under the rubber dam, prepare a thick paste of lime and distilled water. Use a wood spatula whittled from an orangewood stick. No metal should be used at any time in the operation. Apply this to the well opened cavity. Moisten a pledget of cotton with a ten per cent solution of acetic acid. Heat sufficient white baseplate guttapercha to fill the cavity. Then quickly place the small pledget of acid moistened cotton and at once seal the cavity with guttapercha. The chlorine is thus liberated slowly for a few hours. Repeat the treatment daily until the tooth is bleached.

(Note: It is not the purpose of A.D.R. to discuss technical procedures. Such procedures are included in outline only where the process is primarily a chemical one.)

The acid solution (Lorrain Smith's) "eusol" may be prepared by shaking 12.5 gm. of chlorinated lime and 12.5 gm. powdered boric acid with 1 liter of water, allowing the mixture to stand for some hours and filtering.

Alkaline and nearly neutral preparations of hypochlorites are described below. Unless the solutions are made strongly alkaline, they decompose rapidly. Materials made of aluminum should not be placed in hypochlorite solutions.

SOLUTION OF CHLORINATED SODA, U.S.P.—(Labarraque's solution)—Liquor Sodae Chlorinatae (Liq. Sod. Chlorinat.)—An aqueous solution of sodium hypochlorite and sodium chloride containing at least 2.5 per cent of available chlorine. It is made by decomposing a solution of chlorinated lime with sodium carbonate and removing the insoluble calcium carbonate formed.

SURGICAL SOLUTION OF CHLORINATED SODA, U.S.P.—(Modified Dakin's Solution)—Liquor Sodae Chlorinatis Chirurgicalis (Liq. Sod. Chlorinat. Chir.).

An aqueous solution of chlorine compounds of sodium containing 0.43 to 0.48 per cent of available chlorine, free from caustic alkali. It may be prepared by decomposing chlorinated lime with specified amounts of sodium carbonate and sodium bicarbonate in the presence of water. After the precipitate formed has subsided, the supernatant solution is filtered off and adjusted to the required alkalinity and content of available chlorine. It is nearly neutral in reaction.

Actions and Uses: Surgical solution of chlorinated soda is used chiefly as a disinfectant. Diluted with from 15 to 20 parts of water, it may be employed as a spray, gargle or mouth wash.

In the treatment of acute or chronic alveolar abscess, it is beneficial. The involved area may be irrigated daily with this preparation without danger of injuring the surrounding parts. For this purpose, it is used in 0.5 to 1 per cent solutions, but solutions up to 5 per cent have been used without producing pain.

CHLORAMINE PREPARATIONS

HYCLORITE.—A solution of chlorinated soda, each 100 gm. of which is stated to contain sodium hypochlorite, 4.05 gm., sodium chloride, 2.50 gm., calcium hydroxide, 0.14 gm., inert salts, 0.65 gm. It contains not less than 3.85 per cent of available chlorin.

Actions and Uses: Hyclorite differs from solution of chlorinated soda U.S.P. mainly because of the greater content of available chlorine and the lesser degree of alkalinity. Its actions and uses are similar to chlorinated soda U.S.P. When properly diluted, it also may be used in the same conditions as those in which surgical solution of chlorinated soda U.S.P. is indicated. One volume of hyclorite diluted with seven volumes of water has the same available chlorine content as surgical solution of chlorinated soda and is isotonic.

Dosage: Hyclorite is used full strength or diluted with one or two parts of water for direct application to mucous membrane, infected bone, etc. For irrigation of wounds and of throat and body cavities, dilutions of from 1:200 to 1:2,000 are used; as a mouth wash 8-15 drops in a half-glass of water.

Manufactured by General Laboratories, Madison, Wis. Bethlehem Laboratories, Bethlehem, Pa., distributors. No U. S. Patent. U. S. Trademark 120,110.

CHLORAMINE, U.S.P.—Chloramina (Chloram.) (Chloramine-T). Sodium Paratoluensulphonchloramide $CH_3C_6H_4SO_2NaCl.3H_2O$, 1:4. It contains about 12 per cent of active chlorine.

Properties: Chloramine occurs as white or yellowish crystalline powder, having a slight odor of chlorine. It is soluble in water.

Actions and Uses: The actions of chloramine are essentially similar to those of surgical solution of chlorinated soda, U.S.P. It has the advantage of greater stability, convenience of preparation and the production of less irritation. On the other hand, it lacks the solvent action on tissue of alkaline hypochlorites.

It is practically nontoxic. Its use has been suggested for the sterilization of dental pulp canals, for irrigation of alveolar abscesses, for bleaching of teeth and as an irrigating fluid.

Dosage: Chloramine is used in 0.1 to 4 per cent aqueous solution. For wounds, the normal strength is from 1 to 2 per cent applied by the same technic as the surgical solution of chlorinated soda. It should not be taken internally, since it is decomposed by the gastric juice.

Chlorazene: A brand of chloramine, U.S.P.

Manufactured by Abbott Laboratories, North Chicago, Ill. No U. S. patent. U. S. trademark 119,014.

Aromatic Chlorazene Powder: Chlorazene, 5 per cent; sodium bicarbonate, 5 per cent; eucalyptol, 2 per cent; saccharine, 1 per cent; sodium chloride, 87 per cent.

For mouth wash, dissolve about one-third teaspoonful in one-half glass of warm water. Use at least twice a day and make up a fresh solution each time.

Aromatic chlorazene powder has been found useful in irrigation of fistulas and also as a mouth wash in pathologic conditions such as trench mouth, pyorrhea and similar conditions. Used daily as a mouth wash in Vincent's infection, it is said to be a useful agent.

Chlorazene Tablets, 4.6 grains: One tablet dissolved in water to make 30 c.c. yields a 1 per cent solution of chloramine.

DICHLORAMINE, U.S.P.—Dichloramina (Dichloram.) Paratoluenesulphondichloramide, Dichloramine-T. $[C_6H_4\ (CH_3)\ (SO_2NCl_2]$. It contains 28 to 30 per cent of active chlorine.

Actions and Uses: Dichloramine is an effective germicide through its content of active chlorine (Cl). It is only sparingly soluble in water, but soluble in chlorinated eucalyptol or chlorinated paraffin oil (chlorosane, which see). The solution produces a gradual and sustained antiseptic action. Chlorinated paraffin is preferable as solvent because it does not yield free hydrochloric acid. It is more irritant than chloramine, but also more soluble. It should not be administered internally.

Dichloramine is claimed to be used in the prevention and treatment of diseases of the nose and throat. It has been found useful in the treatment of wounds.

Dosage: Dichloramine dissolved in chlorinated paraffin (which see) is used in concentration of from 0.5 to 10 per cent. In pulp canal work, a concentration of 2.5 per cent is useful, although solutions of 5 to 10 per cent have been used. (Marshall, J. A.: Diseases of Teeth [p. 139], Philadelphia: Lea & Febiger, 1926; also Prinz, Hermann: Diseases of Soft Structures of Teeth and Their Treatment [p. 191], Philadelphia: Lea & Febiger, 1928). For application to wounds a 5 per cent solution is employed. The solution of dichloramine in chlorinated paraffin oil is not very stable and should not be kept for more than twenty to thirty days. If the solution becomes irritating to the skin, a fresh solution should be prepared.

Both dichloramine powder and solution, to prevent decomposition, should be protected from sunlight, dust, moisture and organic substances, such as corks or rubber stoppers.

BUREAU OF PUBLIC RELATIONS

DENTISTRY GOES FORWARD

A CENTURY OF PROGRESS—Chicago's challenge to a chaotic world and her greatest show since the '93 Columbian Exposition—has drawn to a successful ending. Twenty-four million people, from every nation and every walk of life, received its magnetic story. It has been called the people's university, it took the world to school, it presented the new age of science, industry, arts and letters. Conceived by men of vision, planned by men of faith, it was developed by the dominant will and financial fortitude of its creators. Chicago's 1933 world's fair will be recorded in history as a gigantic monument to Chicago's spirit and to the men who possessed that spirit, Rufus and Charles G. Dawes and their associates.

No one individual, no small group of individuals alone could have developed this enormous enterprise. The administrative office files contain reams of material, which, when unearthed, will portray how each idea, each unit and each detail was perfected. Some day, that story may be written. This short article can only sketch the part played by organized dentistry in contributing to the exposition's success.

A Century of Progress was the first great exposition that ever invited the professional groups to participate. Thus, for the first time in the history of expositions, medicine and dentistry had an opportunity to present to the public their human welfare activities. Never before had dentistry had the opportunity to deliver its message effectively to such multitudes.

Fully 4,000,000 people from almost every county in every state in the Union filed past the dental exhibit. Each day from 10 a.m. to 10 p.m., a part of this total of 4,000,000—more than there are men, women and children in the City of Chicago—stopped, looked and listened, and all came away with a newer and better knowledge of dental health.

This article is not intended for those dentists who attended the Centennial Dental Congress last August. They saw for themselves. Rather it is written that those who did not attend may be given some idea of organized dentistry's educational effort.

To begin at the beginning: Back in 1929, shortly after the seed of a Century of Progress idea had begun to germinate, representatives from the different sciences were appointed to develop the exposition plans. At the request of President Dawes, an organization known as the Chicago Centennial Dental Congress was formed under the auspices of the Chicago Dental Society and separately incorporated. This congress was granted full powers to develop the dental exhibit for A Century of Progress. The officers of the Chicago Centennial Dental Congress were: Arthur D. Black, president; Hugo G. Fisher, vice president; Stanley D. Tylman, secretary, and Christian Davidson,

①Movie Shows. Dental Health Education
②Mastication
③Anesthesia
④Tooth Brushing
⑤Professional Dental Education
⑥Geo. Washington Dentures
⑦Masks of Orthodontia and Plastic Surgery cases.
⑧Pyorrhea Tooth
⑨Turntable with 4 exhibits of Dentistry in past 100 years
⑩Dental Health Exhibit: Foods, exercise, dental care, etc.
⑪Talking Tooth. Dental caries

Fig. 1.—Diagram showing arrangement of popular dental exhibit, A Century of Progress.

treasurer. The American Dental Association and the Chicago Dental Society cooperated with the Centennial Dental Congress wholeheartedly. The officers of the American Dental Association, G. Walter Dittmar, President, A. C. Wherry, President Elect, Harry B. Pinney, Secretary, and R. H. Volland, Treasurer, and the officers of the Chicago Dental Society, Howard C. Miller, president, D. C. Neymark, vice president, Stanley D. Tylman, secretary, and Edward J. Ryan, treasurer, gave unstintingly of their time and effort.

Fig. 2.—General view of dental exhibit, A Century of Progress.

The Centennial Dental Congress Commission consisted of Arthur D. Black, Hugo G. Fisher, Stanley D. Tylman, Christian Davidson, Howard Alexander, John H. Cadmus, Charles W. Freeman, G. M. Hambleton, C. N. Johnson, Ashley M. Hewett, Paul H. Hoeffel, W. H. G. Logan, Harris W. McClain, Howard C. Miller, F. B. Noyes, V. T. Nylander, H. E. Phillips, Harry B. Pinney, P. G. Puterbaugh, R. J. Sauer and Harold S. Smith.

Organized dentistry owes a debt of gratitude to all of the above named men for making possible this gigantic dental exhibit. Nor did these men work alone. Valuable contributions in ideas, time and especially money were made by the following organizations: American Dental Association, Chicago Dental Society, Los Angeles Study Club, Baltimore College of Dentistry, University of California School of Dentistry, Chicago College of Dental Surgery, Harvard University Dental School, University of Louisville, College of Dentistry, Northwestern University Dental School, University of Illinois, College of Dentistry, North Pacific College of Dentistry, University of Pittsburgh Dental Department, Washington University, School of Dentistry, National Dairy Council, Milk Foundation of Chicago, S. S. White Dental Manufacturing Company, Hanau Engineering Company, American Cabinet Company, Wilmot-Castle Company, Pelton & Crane, General Electric X-Ray Corporation, Heidbrink Company, Colgate-

Palm-Olive Peet Company, Frigidaire Corporation, British Museum, Boston Museum of Fine Arts, American Art Association of New York, Pierpont Morgan Library, United States Army Medical Museum, United States Bureau of Standards, Denver Museum, Los Angeles Museum, University of Chicago, Oriental Institute and Chicago Department of Health.

Respect must also be paid to the many men of the past whose contributions to dental science made this exhibit possible. Bronze plaques on which were engraved the names of deeds of the following men were prominently displayed: Eustachius, 1520-1574; Pierre Fauchard, 1678-1761; John Hunter, 1728-1798; Giuseppangelo Fonzi, 1768-1840; Chapin A. Harris, 1806-1860; Horace G. Wells, 1815-1848; Carl Weld, 1815-1891; Sir John Tomes, 1815-1895; William T. G. Morton, 1819-1868; Jonathan Taft, 1820-1903; James E. Garretson, 1828-1895; Norman W. Kingsley, 1829-1913; Emile Magitot, 1833-1897; William G. A. Bonwill, 1833-1899; Greene V. Black, 1836-1915; John H. Mummery, 1847-1926; J. Leon Williams, 1852-1932; Willoughby D. Miller, 1853-1907; Edward H. Angle, 1855-1930; William H. Taggart, 1855-1933, and Edmund C. Kells 1856-1928.

In the past, various contributions have been made by the dental and allied professions for the advancement of popular dental knowledge. Unfortunately, much of our scientific knowledge of dental disease, known to be essential to individual and community health, has remained uninterpreted and therefore ungrasped and unused. As Nicholas Murray Butler recently observed, "Ideas travel quickly enough in the upper and rarified air of scholarship and highly trained minds, but they move with the sluggish slowness of a glacier over and among the great masses of the population whose habits and whose prejudices are deeply ingraved and whose outlook on life is limited by the walls of their own gardens."

It was the duty of the above mentioned persons to interpret present-day scientific dental facts into terms that lay persons

Fig. 3.—Talking tooth, dental exhibit, A Century of Progress.

could understand and be motivated by. This was accomplished with complete success. The keynote of the entire exhibit was simplicity and directness. Excellent showmanship was displayed in simplifying scientific and technical terms into the language of the multitude.

Owing to the farsightedness of Dr. Black and his officers, an ideal location was obtained for the dental exhibit in the Hall of Science. The main space, 146 feet in length, extended in a slight arc from the "transparent man" to the eastern doors of the building. These doors led to the bridge that joined Northerly Island to the mainland. Visitors passing to and from the island from the Hall of Science had to pass the dental exhibit. Likewise, thousands of visitors drawn to the much publicized transparent man paused at the dental display.

Fig. 4.—Masticating apparatus of tiger, man (natural and artificial) and mountain sheep, with, below, types of food which each is adapted to chew; dental exhibit, A Century of Progress.

Twelve feature exhibits were always

in operation. Through the magnetism of motion, light and sound, they constantly attracted attention. Twenty-five large showcases containing interesting and historical material held the interest, once it had been attracted. Just inside the Northerly Island entrance was a seventy-five chair open-sided theater. (Fig. 1.) In this theater was shown a new twelve-minute talking picture, "Nature, Builder of Teeth," which graphically described, both by drawings and photographs, the calcification and the development of teeth from birth to the eighteenth year. Lessons in diet, cleanliness and dental atention were given in the lecture accompanying the film, which operated every alternate twelve minutes for twelve hours each day. From June 1 to September 1, H. W. Ferguson presented a twenty-minute dental health puppet show entitled "Jimmy Chew." By the use of large dental dolls and models and by employing the art of ventriloquism, Dr. Ferguson presented an instructive and interesting dental health message to both adults and children. Undoubtedly, this is the most unique show of its kind ever developed. Between 150 and 200 people filled the seats and crowded the adjoining aisles at each performance.

SPECIAL BRUSH INSTRUCTIONS BY THE DENTIST ARE OFTEN DESIRABLE
VIGOROUS BRUSHING OF THE GUMS HELPS TO PREVENT PYORRHEA
INNER SIDE OF UPPER BACK TEETH PLACE BRISTLES ON GUM AND ROTATE BRUSH DOWNWARD OVER GUMS AND TEETH
CHEWING SURFACES OF ALL THE TEETH SHOULD BE BRUSHED BACK AND FORTH WITH HEAVY PRESSURE

Fig. 5.—Proper tooth brushing method, dental exhibit, A Century of Progress.

On the side and back walls of the theater was a large mural painted by Lord Hastings portraying how the dental profession carries its dental health message to the remote sections of the country. In the showcases surrounding this theater, exhibits of early dental instruments,

good and poor filling materials and models showing the progress of decay and the progress of pyorrhea were shown. In Section 2, which faced three main aisles, a motivated masticating exhibit drew a tremendous crowd. This exhibit consisted of a mounted tiger skull, mountain sheep skull and human skull. The mandibles of each of these skulls moved in a manner typical of their species. Mounted beside the human skull and synchronized with it was a set of articulated dentures. This exhibit clearly demonstrated the different jaw movements of the carnivorous and herbivorous animals. It also demonstrated the complex mandibular movements of man and showed how dental science can reproduce tooth form and color and duplicate the human masticatory movement.

Section 3 was devoted entirely to anesthesia. Historical data pertaining to the work of Morton and of Wells; early cocaine and procaine syringes, and a testimonial to C. Koeler for his discovery of the anesthetic properties of cocaine and to A. B. Luckhardt on his rediscovery of ethylene were displayed. The work of Einhorn and Braun, introducers of procaine, was shown. Five large machines for the administration of nitrous oxide occupied the center of this space, portraying the progress and improvement made in that type of anesthesia from 1860 to the present date. Each day at 3 and at 8 p. m., a demonstration of the anesthetic properties of a local anesthesia was given by immersing goldfish in a dilute solution of procaine. Adjacent to this was a 4 by 3 x-ray shadow box in which various roentgenograms of normal and abnormal dental conditions were shown.

One of the most interesting and best attended exhibits was the tooth-brushing demonstration in Section 4, consisting of a large motor-driven hexagonal structure, modernistic in design, on each side of which was an aluminum head, arm and hand. A toothbrush was held in each hand so that the bristles rested on the teeth inside each open mouth. The hands were so motivated that each of the six heads demonstrated one tooth-brushing movement. As the entire hexagon revolved upon its base, the spectators could observe the six demonstrations by remaining in one position for a period of three minutes. In an adjoining showcase, a collection of early and unusual tooth-brushing devices were shown, as well as samples of good and of poor types of brushes. A second case in this section showed injured elephant tusks, a mammoth's mandible, presenting a pathologic condition and the jaws of a saber-tooth tiger.

Section 5 showed the progress made in dental education during the past 100 years. A small model of the first dental school in the world, the Baltimore College of Dental Surgery, established in 1840, was part of the exhibit. A large model representing dental education of the present day was shown. This model was sectioned into rooms, each room representing one course of study and each equipped with miniature furniture and cutouts of students at work. An electrical transcription described the models and called attention to a picture of Horace Hayden, founder of the Baltimore College of Dental Surgery. Two large showcases protected the models from the public. These cases also contained a number of dental books, dating from 1530 down to our present day dental index. As was anticipated, this exhibit was of particular interest to students, teachers and professional people.

Directly in front of Section 5 was Section 6, in which was displayed one of the most interesting exhibits of the entire

fair. One set of George Washington's dentures rested upon a black velvet cushion amply protected by a blue steel safe and shatter-proof glass. These were loaned to the Congress by the Baltimore College of Dental Surgery. It is problematical whether the transparent man, the mechanical robot or Washington's teeth drew the largest crowds. Pictures of life masks of Washington and reproductions of paintings of him by Peale and Stuart showed the change in facial expression resulting from his loss of teeth and the use of these dentures. A picture of John Greenwood, Washington's dentist, was also on exhibition. One of the showcases in front of this section showed the progress made in crown and bridge construction from the days of the Egyptians down to the present time. The other case contained specimens of early French, American and Japanese dentures.

In Section 7, in a semicircular full length glass case, orthodontia, prosthetic and plastic surgery models were shown. One part of this case was left open that mechanically inclined visitors might witness the banks of electrical phonographs which motivated the various exhibits.

Section 8, immediately in front of Section 7, contained the pyorrhea tooth exhibit, consisting of a framed groundglass 9 feet high by 4 feet wide. Behind this glass, 1,200 electric lights were wired in an elaborate system of shadow boxes. These lights were operated by the phonographically controlled mechanism mentioned in Section 7. This mechanism described and displayed the progress of a pyorrhea pocket from a small beginning until the pericemental membrane was completely destroyed. The electrical phonograph described some of the most common causes of pyorrhea and the synchronized lights clearly demonstrated its progress. In one of the show cases directly in front of this exhibit, early and unusual dental drills were displayed. In the other case was shown the development of the teeth from their early germ stages until complete eruption.

Section 9 showed the progress made in dental service during the past 100 years. Four stages were mounted upon an automobile turn table, each stage occupying one quadrant. In the first scene dentistry as it was practiced 100 years ago by the itinerant dentist was shown. The second scene portrayed the dentist and his assistant of fifty years ago. The third scene was a modern dental office, while the fourth showed a 1933 dental hygienist's office with a school boy in the chair. The last scene was included in order to emphasize the importance of early care of children's teeth. The turn table revolved once every twelve minutes, allowing three minutes' observation of each scene accompanied by phonographic description. Needless to say, from twenty to fifty people watched this clever exhibit at every revolution.

Section 10 consisted of a full length semicircular glass plate behind which lighted pictures of food and people of different age groups were shown. This demonstrated the relationship of proper foods to good health.

Section 11 displayed the popular talking tooth. Its construction was similar to that of the pyorrhea tooth, the two being companion exhibits. The exhibit consisted of a 9 by 4 glass plate behind which 1,200 lights were mounted. These lights were intricately wired and controlled by the phonograph mechanism. As they flashed on, they first showed the outline of the tooth and next the beginning of decay in the occlusal surface. Gradually, the decay pierced the enamel, penetrated the dentin and exposed the

pulp. By the use of red and green lights, inflammation and death of the pulp were clearly illustrated. Finally, an abscess formed at the apex of the root and the loss of the tooth was shown. The phonographic accompaniment not only displayed the progressive stages of decay, but also gave the audience valuable information as to the importance of early dental attention.

In one of the cases immediately in front of the talking tooth, early extraction instruments were displayed. In another, reproductions of some cuneiform tablets describing early dental conditions were shown. In the third and fourth cases, wax models of syphilitic and cancerous mouth lesions were exhibited. Lastly, in one corner of this room, facing the main west aisle, was a statue of St. Appolonia, patron saint of dentistry.

The exhibit of the Chicago Centennial Dental Congress at A Century of Progress was in every sense of the word a success. It was a gigantic achievement, conceived by men of vision, dedicated to humanity and executed through the combined efforts of the American Dental Association, the Chicago Dental Society and their friends. The first big attempt by organized dentistry at mass education, it clearly and concisely defined dental health in lay language. Thousands of individuals, especially children, will profit by this exhibit. It is only the beginning, paving the way for more and even better educational efforts by the profession in the future.

BOOKLET ON CARE OF THE TEETH NOW READY

A NEW booklet "The Care of the Teeth," for professional and lay educational purposes, approved by the American Dental Association and the United States Public Health Service, is now ready.

It is with pleasure that the Bureau of Public Relations presents to the profession the latest and most complete brochure on "The Care of the Teeth," for lay consumption. It will unquestionably supply your needs for a brief, clear-cut, well-illustrated booklet on children's teeth, such as every dentist has desired; an authoritative and scientific, yet nontechnical pamphlet on this important subject to hand to your patients. Send your request in early as a deluge of orders is anticipated.

The "Care of the Teeth" is a 32-page booklet prepared in the interest of the children of America by Herman N. Bundesen, president of the Chicago Board of Health, in cooperation with the Bureau of Public Relations of the American Dental Association. It bears the approval also of the United States Public Health Service, Hugh S. Cummings, Surgeon General.

In its preparation, infinite care has been used to couch all technical terms in lay language without distorting its scientific content. It is illustrated with eighty beautifully clear photographs of actual cases and models. Their accompanying captions, legends and overprint enable each illustration to tell its own story. It is just the kind of book on this subject that you have been waiting for, the type of book that every mother, nurse, hygienist, teacher and health worker will want for their own use when they see it in your office.

We wish it were possible to print all

of this booklet in THE JOURNAL. This is not possible, of course, because of lack of space. The booklet opens with a story:

When little Helen was 4 years old, her health began to fail . . . at eight, she was already one year behind her class. . . . Helen's mother was worried about her . . . but she did nothing about it. At last . . . she took Helen to the doctor . . . who did not find the cause of her trouble until he gave the command "Open your mouth and say 'Ah.'" . . . How in the world could her mother have neglected her so? Several teeth . . . were decayed, broken and jagged. . . . Her teeth and lips did not come together properly. . . . "Helen's trouble is in her mouth . . . take her to a dentist before you have something to regret all the rest of your life." "But Doctor," answered Mrs. Roberts . . . "they are only baby teeth . . . they are going to fall out . . . new ones will take their places." "You are making a grave mistake . . . when you say that," the doctor answered. "It is as important to keep baby teeth strong . . . as it is permanent teeth . . . besides Helen's first permanent molars have not escaped decay." . . . So Helen went to the dentist. . . . He removed the teeth that were too badly infected to be filled. . . . He repaired the others. . . . He cleaned her teeth . . . and taught her how to brush them properly.

Fig. 104—FOODS BUILD STRONG TEETH
Children should have, among other things, about a quart of milk each day because it contains lime and phosphorus, both of which are needed for good teeth.

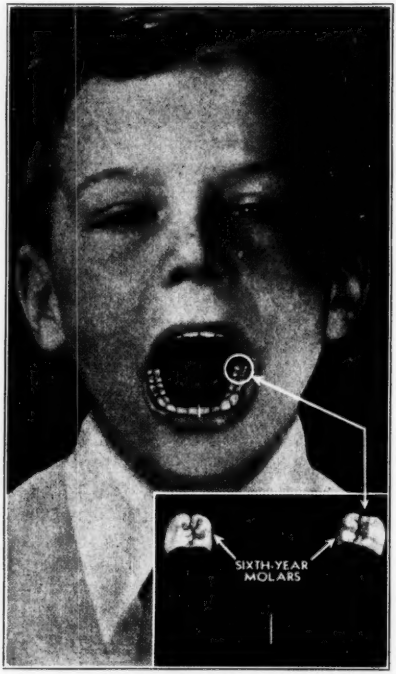

Fig. 130—THE SIXTH-YEAR MOLARS—THE MOST IMPORTANT TEETH
The sixth-year molars are the sixth teeth back, counting from the front center of the mouth. They come in at about six years of age. They are permanent teeth—not baby teeth. Watch for them. Be sure they are well-formed so they do not decay.

He gave Mrs. Roberts a list of foods that should be eaten every day to keep the teeth and gums healthy. . . . The improvement in Helen was wonderful, she was like a different child . . . full of energy and pep. . . . When Helen was well enough, the dentist fastened some braces on her teeth to straighten those that were crooked. . . . By the time she is 14, she will have one of the loveliest sets of teeth imaginable. . . . How near Helen's mother came to making the mistake of

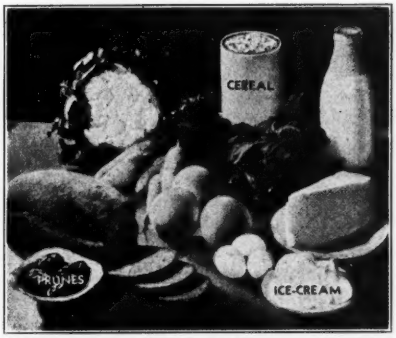

Fig. 131—LIME IS NEEDED TO BUILD STRONG TEETH

A quart of milk a day will supply all the lime the body needs, and some extra lime will be obtained if the child eats still more of the other foods shown above.

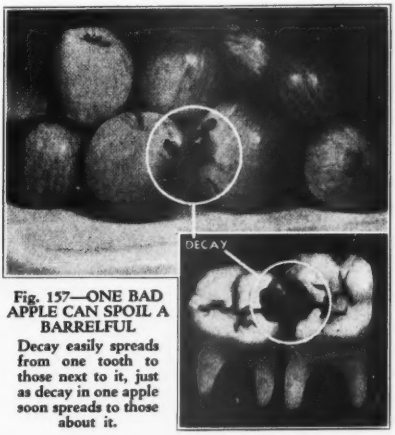

Fig. 157—ONE BAD APPLE CAN SPOIL A BARRELFUL

Decay easily spreads from one tooth to those next to it, just as decay in one apple soon spreads to those about it.

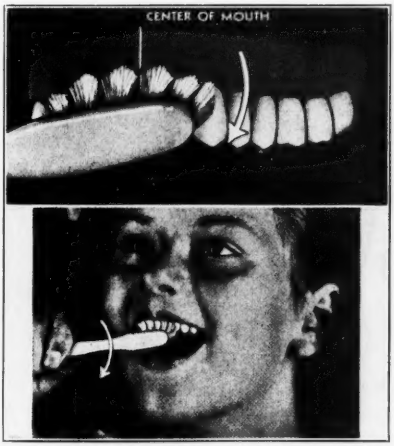

Fig. 149—OUTSIDE SURFACES OF THE FRONT TEETH

Place the bristles of the brush on the gums over the upper front teeth. With a rolling or sweeping motion, brush these teeth downward from the gums, over the necks of the teeth, to the biting surface. This should be repeated at least ten times.

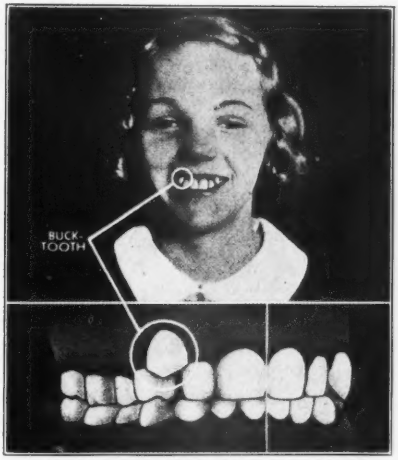

Fig. 170—CUSPIDS COMING IN CROOKED

The early loss of the baby molars keeps the jaw from growing as large as it should. The bicuspids of the permanent set then are crowded forward. This, in turn, takes up the space needed by the permanent cuspid which comes in out of line in front of the other teeth and is called a "buck-tooth."

neglect! . . . Many parents are guilty of that mistake today. . . .

This human interest story paves the way for thirty pages of carefully prepared, interesting and scientifically correct information on the care of children's teeth. A list of some of the major subtitles follows:

What are teeth like?
Each tooth has its special duty.
Why we have two sets of teeth.
What mothers should know about baby teeth.
Why the baby teeth are important.
When the baby teeth fall out.
The "second" teeth, when and where they come in.
The most important teeth of all.
Watch for the sixth year molars.
Why you must guard the sixth year molars carefully.
What foods do for teeth.
Foods that build strong teeth.
Foods that strengthen teeth and gums.
Foods clean and exercise the teeth.
Why teeth must be kept clean.
The correct toothbrush for children.
The care of the toothbrush.
The right and wrong places to keep the brush.
What to use for cleaning teeth.
Teaching the child to brush the teeth.
How to brush the teeth.
The use of dental floss.
Rinsing the mouth.
What makes teeth decay.
The tragedy of tooth decay.
Children's diseases resulting from poor teeth.
How biting hard objects affects children's teeth.
Effects of one decayed tooth on other teeth.
Toothache as a result of decay.
Decay and abscesses.
Effect of decayed teeth on scholarship.
Dangerous effects of tartar on the teeth.
Why stains on the teeth should be removed.
What causes crooked teeth.
Why crooked teeth are unhealthy.
Advocates beneficial results of having teeth straightened.
How pain and sickness could be avoided by frequent visits to the dentist.
When and why the child should go to the dentist.
What the dentist can do for the child.
The dentist as the child's friend.

The above listed subjects are not only clearly explained, but are also graphically illustrated.

Arrangements have been made whereby the Bureau of Public Relations can distribute this booklet at the cost of printing and mailing.

Single copies, 10c.
12 copies, $1.00.
50 copies, $4.00
100 copies, $7.50
500 copies, $25.00

DENTISTRY AND PUBLIC HEALTH

IN accordance with a plan developed by the Educational Publicity Committee of the Board of Trustees and approved by the House of Delegates last August, the American Dental Association is inaugurating a national dental educational program.

This program provides for the preparation and distribution of three types of educational material:

1. Newspaper articles:

(*a*) One series of fifty-two articles, from 300 to 500 words in length, on different dental subjects; to be inserted weekly by state and local dental societies in the city and larger town papers.

(*b*) One series of fifty-two articles, from 50 to 100 words in length; short, pertinent articles on dental subjects suitable for insertion in small rural papers.

(*c*) News flashes; to be released, when advisable, to the several national news services.

2. Radio talks:

(*a*) One series of five-minute radio talks on different dental health subjects.

(*b*) One series of ten-minute radio talks as above.

3. Short lectures for lay and civic groups. Some of these will be prepared in outline form only; others will be complete lectures.

All of this material will be prepared or assembled and distributed to state and component societies by the Bureau of Public Relations. Before being released, each article will be approved by the American Dental Association and the United States Public Health Service.

A standard heading, such as is illustrated immediately above, will be placed on each article. Before using this material, state and component societies are urged to secure, if possible, their approval by their local health officers. Local official approval will add news value to the article.

HOW THE NEWSPAPER MATERIAL CAN BE USED

A list of instructions regarding the use of newspaper articles will accompany each set of material. These instructions can be summarized as follows:

1. Write to the Bureau of Public Relations, American Dental Association, for newspaper releases.

2. Secure the approval of these releases by your state or local health officials.

3. Arrange with the managing editor of one of your local newspapers to print one of these articles weekly. (Most editors will be glad to print authentic material of this kind if properly approached. Approach may be made by a committee of dentists from the local society or it may be made by a dentist who is a personal friend of the editor.) Personal contact between the officers of the local dental society and the editor is essential. Do not expect busy newspaper men to publish a series of articles unless you explain the entire plan to them. Explanation of this kind can not be made by 'phone or letter. Personal contact brings best results.

HOW THE RADIO MATERIAL CAN BE USED

1. Secure the articles from the Bureau of Public Relations of the American Dental Association.

2. By personal contact with the officials of the local broadcasting company, secure five or ten minutes' time per week on its station. Almost every American radio station devotes some time each day to public service programs. Most stations, if properly approached, will allocate five or ten minutes of this time once a week for dental health talks.

A regulation announcement will accompany each talk and should precede the radio speech.

Some component societies may prefer to have each weekly talk presented by a different member; others may prefer to confine the delivery to one or two men who have good radio voices. That is a matter for local decision. The utmost care should be used in selecting speakers. Use the best radio voices in your society.

The first of these newspaper and radio articles, bearing the approval of the American Dental Association and the United States Public Health Service,

will be ready by Jan. 1, 1934. Notices will be sent to every state society with inclosures for the state society to send to each component society. All articles will be prepared in mimeographed form and a slight charge to cover cost of mimeographing will be made. With every state and local society actively participating in this program, half the newspapers and radio stations will soon be carrying weekly authentic dental health material.

The Hutchinsonian Tooth

Dr. De Jonge-Cohen, of Amsterdam, whose work on the morphology of the teeth is well known, has made an interesting contribution to the literature on the teeth in congenital syphilis (*Tijdschrift voor Tandheelkunde*). Commenting on the tendency to disappearance of the central tubercle of the upper central incisor, Dr. Jonge-Cohen points out that this may have some significance in the etiology of the Hutchinsonian tooth. If the absence of a central tubercle leading to a notch is due to degeneration then it follows that such an appearance occurring in a person with congenital syphilis cannot have any pathognomonic significance as laid down by Hutchinson. But Dr. Jonge-Cohen also goes on to point out that there is much confusion as to what really constitutes the type of tooth described by Hutchinson as characteristic of lues. It is not hypoplasia, which may co-exist, but is itself unconnected with the disease; neither is the presence of a notch the sole determining feature. Jonge-Cohen quotes the original statement of Hutchinson which makes it abundantly clear that he himself never regarded eroded teeth as due to syphilis, but thought them due to stomatitis. He lays it down definitely that in addition to the presence of a notch, there is the "screw-driver" shape leading to a narrowing towards the cutting edge which is almost as characteristic as the notch. Associated with the absence of the central tubercle of the centrals, there is often a dwarfing of the lateral incisor. This is also present in Hutchinsonian teeth. But here again this fact that absence of the central element of the central incisor and a reduction of the lateral may occur in syphilitic persons and in those without any such disease does not warrant the conclusion that the dystrophies described by Hutchinson are accidental occurrences and not due to syphilis. According to Jonge-Cohen, the original statement of Hutchinson holds good that in Hutchinsonian teeth there is both a convergence of the sides of the tooth and a central notch. Both of these conditions must be present in order to establish a diagnosis of syphilitic teeth.—*Brit. D. J.*

CURRENT LITERATURE

What the Pediatrician Can Do For Dental Cripples (Cleophas P. Bonin, New England J. Med., Nov. 2, 1933): This paper was presented before the Annual Meeting of the Massachusetts Medical Society, Section on Pediatrics. Slides were shown to demonstrate the effects of orthodontia, to prove to a medical group its need, its benefits and the conditions where it is needed, but not employed. Casts were also used in illustration. The author's objective was to induce pediatricians to observe crippled mouths, as well as crippled extremities or vertebrae, as a part of their service. He dissuaded them from the belief that orthodontia might cause or add to nervous conditions if in the hands of capable men. He stressed the idea that the older the patient is the greater the complications. The future of dental cripples is always mortgaged. The lack of important information on the etiology of malocclusion is conceded, but it is stated that enough is known to enable orthodontists to render a tremendous service to dental cripples.

T.

White Blood Cell Count: Scarcely a day passes in the lives of many physicians when they are not concerned with the "white blood cell count" of some patient. To base a diagnosis of disease on an aberration in the number of circulating leukocytes calls for dependable knowledge of normal conditions. Without this, rational judgments as to what constitute abnormal changes or pathologic signs cannot be formed. Just as the clinician takes into account the diurnal variations in body temperature when he uses the clinical thermometer, so the "rhythms" in white cell counts need to be considered if they are indeed, physiologic realities. An "afternoon rise" has been described as an actual phenomenon, in contrast to some other variations now attributed to errors in technic. Reference was made some time ago in *The Journal* to the conclusion that so-called digestive leukocytosis has been wrongly ascribed to alimentary causes. It was argued that physical or even mental exertion is the most conspicuous reason for these normal fluctuations in the increased numbers of white blood cells so often recorded after meals. Garrey of Vanderbilt University at Nashville, who championed these views, contended that a count above 7,000 per cubic millimeter is evidence of mental or physical unrest and that all "basal counts" lie between the limits of 5,000 and 7,000. Extensive investigations at the Washington Square College of New York University do not support this view, but tend to indicate that mild activity has no constant effect on the count, although, as is well known, severe exercise may cause the number of leukocytes to rise to three or four times the normal figure. In persons at rest, counts between 4,700 and 11,500 were obtained, while the counts during activity varied between 3,500 and 11,500. The counts taken during activity were not uniformly higher than those obtained during complete rest, and just as frequently the two counts were substantially the same, or the count during activity was lower than during complete rest.—*J.A.M.A., Oct. 14, 1933.*

Mottled Enamel (N. J. Ainsworth, Brit. D. J., Sept. 1, 1933): With photographs, photomicrographs of ground sections of mottled teeth and tables, Ainsworth shows his findings from examinations conducted in Maldon, Essex, where mottling is endemic. His conclusion is as follows: The distribution of the stain, first on the most prominent part of the exposed teeth, spreading gradually to less prominent parts, and then to the most prominent part of the teeth second in order of exposure, points to an outside origin for the stain, either atmospheric or in the water, since these are precisely the surfaces most exposed to air and fluid in the acts of speaking and drinking respectively. The author says: "My own view, and it is little more than a guess, is that the cause of both mottling and stain will be found in some quality or impurity of the drinking water not ascertainable by ordinary analytic methods, the first condition being an interference with, or modification of enamel growth, the other a mechanical infiltration from without inward. The impurity, if such it is, may conceivably be bacterial or minute quantities of a substance not found because

not tested for in routine analyses." The analysis of the water showed a fluorine content of 4.5-5.5 parts per million. That used for content showed a 0.5 flourine content per million. This is noticeably over the critical figure given by Smith and Lantz as 1.5.

T.

The Caries Chaos (Edward Samson, Brit. D. J., Oct. 16, 1933): The author begins his discussion with a statement from "Dental Surgery and Pathology" by Sir Frank Colyar. He notes Colyar's omission of a cure for the malady and says that "the cure for caries is still as distant as ever." That omission of Colyar's occurred years ago. Samson's address and comment occurred in July, 1933. Colyar's remedial procedures then, were filling and crowning. If these were ineffective, then extracting, a sad anticlimax to a noble beginning. Says Samson: "Years later I am still employing that primitive method of cure. I am no nearer (today) to saving mankind from either caries or dentists." Brilliant theories have since arisen to confuse the mind. The first is of bacteria—biochemistry. *B. acidophilus* came and went. Vitamins came with promise of rescue. Golden days were ahead, but the shadow of Sim Wallace dimmed the hope of the hour. Helen Mackay and Mary Swartz Rose delete vitamin D as an important factor. Next endocrines grip the imagination. A theory for their influence on teeth parades for a time. Few dentists are capable of understanding or explaining their criss-cross path and effect, including the writer. There is, doubtless, hope here if—. But today darkness prevails. We are far removed from the lactic acid of Colyar and Miller, but forceps are the only undisputed cure. Endocrinology leads to physiology and psychology and psychology leads where? Heredity. And that implies genetics and evolution. Caries has led us far. We come now to a return to the simple—to milk, and a storm rages around it. Eggs find favor either in connection with or distinctive from —he doesn't know which. The "Oslo breakfast" is proclaimed successful if fed to children, their mother and grandmother. It is all straight forward and straight backward, but in whatever direction arrives at the forceps. Geography adds its distances from cure. Tristan da Cunha, Tibet, China; Hebrides, Rhodesia, Switzerland; Samoa and Laborador bear evidences that puzzle and confuse, but leave the dentist to a study of extraction and prosthesis—just where he started. Samson ends: "Alimentary, my dear Watson, alimentary."

T.

Foreign Literature

Penetration of Teeth and Roots into the Maxillary Sinus (G. S. Bjalik, Ztschr. f. Stomatol., 29: 607-613, 1931): The penetration of teeth and roots into the maxillary sinus is not always a result of lack of surgical skill. The cause may lie in the anatomic structure of the maxilla or in some periapical pathologic process. In the case of the latter or deep-seated roots, it is advisable to remove the roots surgically. In case of penetration into the sinus, the removal of the root should be attempted through the canine fossa and not through the alveolus. The operation should be as early as possible.

I. S.

Abnormal Size of Tongue as Cause of Malocclusion (K. Wachsmann and F. Neumann, Ztschr. f. Stomatol., 29: 32-44, 1931): The presence of an abnormally large tongue causes a spreading of the dental arch and a corresponding spacing of the anterior teeth. The cases may be divided into three groups: (1) a uniform lower and upper protrusion; (2) a protrusion of the lower jaw because of the absence of an overbite or the height of the body of the mandible; (3) an open bite because the tongue rests in part between the upper and lower anterior teeth. The tongue often shows fold formation. The heredity of this anomaly has been frequently observed. The authors propose a wedge-shaped excision as a therapeutic measure. These anomalies are not rare.

I. S.

Further Studies on Metabolism in Cases of Paradentosis (Karl Breuer, Paradentium, October, 1933, pp. 30-31): Close study of twelve cases of paradentosis reveals that the majority of cases show a normal basal metabolism. The specific dynamic albumin index, taken from three to five hours after a meal in cases of paradentosis, was lowered. In cases of dystrophia diffusa, the specific dynamic albumin index was lowered, while in cases of paradentitis profunda simplex and dystrophia complicata, the index was found to be raised. The author concludes that the determination of the specific dynamic food effect in the diagnosis of a true Gottlieb's diffused atrophy corresponding,

more or less to a dystrophia diffusa cannot be taken as an aid in differential diagnosis of the disease.

O. K.

Paradentosis—Pathogenesis (L. M. Lindenbaum, Ztschr. f. Stomatol., 31: 1933, pp. 1045-1068): A systematic examination of 1,010 cases of paradentosis in relation to their blood grouping and genotypical constitutional condition of paradentosis is reported. The majority of patients with paradentosis suffer from infectious diseases such as influenza, typhus and malaria, a group of diseases which, according to their patho-anatomic influences on the human organism, belong to that general group of infections which cause stasis, thrombosis and obliteration of the arterioles and capillaries. These occurrences are associated with metabolic disturbances and atrophy of affected areas. On the basis of this study, it is logical to state that the pathogenesis of paradentosis is connected with lesions of the vascular end apparatus of the paradentium. These vascular alterations are brought about by certain infectious diseases (influenza being the chief one) which influence both the vascular apparatus and the nervous system controlling this apparatus. Other factors may enter into the functional state of the general vascular system, especially the vascular end-apparatus. Very often, paradentosis is a constitutional disease.

O. K.

Experimentation with Arsenic (Max Wacherlin, Deutsche Monatschr. f. Zahnheilk. 51: 721-744, 1933): Thorough clinical and histologic investigations show that the application of colloidally dispersed metalic arsenic in pulp devitalization is not to be encouraged. In nonexposed pulps, it brings about very painful and dangerous results. In cases of pulp exposure, it brings about periapical disturbances. Metabolic arsenic, when applied to the pulps, is regularly carried away by the blood stream of the pulp; hence, its usefulness as an anesthetic in pulp therapy is very questionable. Even in cases wherein the arsenic does not pass beyond the apical foramen, the pulp stump is overloaded with arsenic crystals and becomes a source of danger to the vitality of the periodontium. The arsenic diffusion in the periodontium has a inhibiting rather than a stimulating effect on tissue regeneration after filling of root canals.

O. K.

Silver Root Canal Filling (Jan Fridrichovsky, Zubni Lekarst., September, 1933, p. 278): The author recommends silver as a root canal filling material because, as he uses it, the canal can be hermetically sealed and no harm will result from forcing some of the material through the apex. After a thorough cleansing and drying, the canal is pumped full of a silver cement, containing 1 part chemically pure silver and 3 parts cement. A silver root canal point is inserted to complete the filling.

E. S.

Drilling and Grinding (P. J. J. Coebergh Tydschr. v. Tandheelk., July, 1933): The respective virtues of the methods of Huet (Belgian) and Salzman-Scheiber (German) to drill at high speeds with varying pressures are discussed. The object is to reduce pain. This high speed would require changing our engines, with resultant expense and complications due to frequent breakdowns. Extensive experiments have been made. As to the results, the conclusion is that, in drilling with a round bur of new type design, low speed and heavy pressure will get the quickest results with the least pain; while, in grinding, high speed and slight pressure should be used.

F. VAN M.

Research in the Qualities and Constitution of Stents (Modeling Compound) (B. R. Bakker and U. Bakker-Land, Tydschr. v. Tandheelk., July, 1933): Except for slight additions, modeling compound consists of resin, stearine acid and talcum, in proportions approximately of 25:50. If we accept these figures as normal, then modeling compound so constituted consists, above 40 C., of a very tough liquid suspension of talcum in a solution of stearine acid in resin, which can reach a concentration of 28 per cent according to the C.T. diagram. Below this temperature, this solution is interwoven with a network of stearine crystals. Also, below 40 C., the mass remains essentially a liquid, which can be changed in form through small persistent forces. The elasticity of this cold mass is due to the crystal skeleton. When we raise the temperature 1 or 2 degrees above 40 C., the liquidity of the mass increases rapidly. For changing in form of the mass at these

temperatures, time is a more important factor than force. The temperatures, their respective concentrations and the degree of liquidity are directly related to the constituency of the material. A direct relation between all technical qualities and the chemical composition was not demonstrable. More technical research is needed on this point. It was shown from numerous data that the objective differences between the various makes is not nearly so great as one would be led to believe from the information supplied from commercial sources. From the theoretical consideration and also from the practical measurements and observations made, the conclusion follows, for the man in practice, that it is very desirable to determine an optimal working-temperature of the material to be used and to be guided by this temperature in our work. For clinical reasons, this temperature should be chosen as low as possible, but at the same time so high that a pressure suitable for application in the mouth, during the time at our disposal, will actually produce sufficient compression. We should remember that we cannot overcome a temperature that is too low, neither through increasing the pressure nor through increasing the time period, and that too short a period of time pressure cannot be neutralized by increasing the force. The most important qualities of modeling compound can be expressed nonclinically best in a temperature-compression curve.

F. VAN M.

Incisal Reductions in Upper and Lower Jaw (Th. E. De Jonge-Cohen, Tydschr. v. Tandheelk., July, 1933): Certain reductions of incisors in the permanent dentition were described. Following up the dentition formula: C+J. I J. I+C of the upper jaw, the future dentition of the lower jaw was summarized in the formula: C. J.II ++ J.II C; similarly, for the deciduous teeth, in connection with which, in case of the very rare occurrence of a bilateral symmetrical reduction of incisors in both jaws, we might construct homologous dentition formulae.

F. VAN M.

MISCELLANY

BOOKS RECEIVED

Index of the Periodical Literature for 1927-1929. Compiled by Arthur D. Black. Published by the Dental Index Bureau, 212 East Superior St., Chicago, Ill.

Bacterial Infection. By J. L. T. Appleton, Jr., second edition, thoroughly revised. Illustrated with 122 engravings and 4 colored plates. Lea & Febiger, Philadelphia, 1933. Price $7.00 net.

Diet and Dental Health. By Milton T. Hanke, Ph. D.; published by the University of Chicago Press, Chicago, Ill., October, 1933. Price of limited first edition, $1.00; after February 1, $4.00.

DENTAL LABORATORY CODE

The developments in connection with the dental laboratory code have been so rapid and conflicting that it has been practically impossible to keep up with all the changes, but we respectfully submit the following in order that you may be promptly advised that the hearing closed last midnight.

October 13, Dr. Brownson and others from California wired requesting that I telegraph the state society Officers, asking them to wire General Johnson for a forty-five day postponement. From telephone and wire information, I realized that telegrams of this nature had been sent to all the state society secretaries. Very soon thereafter, Dr. Cole phoned that the hearing was scheduled for October 20, confirming my information, and urged that I arrive in Washington on October 17, if possible, and arrangements were made accordingly. In this phone conversation, he advised of the receipt of a wire from the California group, but it was agreed that we should postpone making a specific request until after a conference, which was called for Tuesday night.

This question was so serious that I advised President Wherry of conditions and he sent a wire inquiring whether I thought it would be advisable for him to come to Washington. I promptly wired, "Your presence will be most helpful. When will you reach Washington?" Further telegrams

passed between us as well as between him and Dr. Camalier, and he reached Washington by plane in time to attend the conference Tuesday night. I also wired Dr. Pruden to join us, and only regret that distance made it impractical for Dr. Brownson to come. The following were present: President A. C. Wherry, Vice-President H. C. Harvey, Drs. Cole, Pruden, Robinson, Brown, Camalier, Messner, Wyman, Erickson, and Simkins, President, Vice-President, and Secretary of the District of Columbia Dental Society. We thoroughly canvassed the entire situation and about midnight a telegram was formulated and sent to the secretaries of all the state societies. The response was very prompt and general. For instance, a secretary of one of the deputy administrators told me at the preliminary hearing on Thursday that they had received telegrams from forty-six states, and, in many instances, a great number were received from each, and we all appreciate this cooperation. The overwhelming appeals which had reached all of us were to oppose the laboratory code in its entirety, and our plan as developed Tuesday night was in support of this procedure. After we came in closer contact with the problem, it was generally recognized that a code would probably be adopted. It also became evident that the proposed code could not be withdrawn, neither was there any possibility of securing a postponement as had been suggested; but rather that we were face to face with an immediate serious problem. Our program Tuesday night was developed as being opposed to a Code, but we insisted that certain provisions of the proposed code be drastically modified in the event that the N.R.A. overruled our position.

On Wednesday, we made contact with several of the officials and our reaction was that they considered the dental laboratory an industry and subject to codal regulations. We were fortunate in conferring with Colonel Lea, assistant administrator to General Johnson, and Major Paddock late Wednesday afternoon, as this gave us a better insight into the attitude of the administration. Both Majors Paddock and Dickinson were present at the preliminary hearings, which lasted all day Thursday, and the final hearing, which commenced at 10 o'clock yesterday and closed at midnight. There were many and varied arguments presented, and every member of our group commented on the fair and efficient manner shown by the officials during both the preliminary and the final hearings. Labor had several representatives present and made some unreasonable and impossible demands. In view of the activities of Dr. Brownson and Dr. Palmer, and their associates, we sent them night letters, and I incorporate the wording of one of these as it was agreed on by several of us following the closing of the case last night.

"Hearing completed. Case closed at midnight. Decision will not be reached for probably two weeks. Have been unable to report earlier as the critical situation changed hourly. Large labor representation injected unreasonable and impossible demands. Our protests against code favorably received, but unanimous opinion of group is that a code is inevitable due to administrative policy. After a week of intense strife, we are confident that profession will not suffer materially. President Wherry's presence was a dominant factor in results. Thanks for your cooperation."

The two most controversial questions at the close of the hearing related to the pay and hours of the technicians and administration of the Code. I feel justified in saying that provisions will be made for at least a skeleton service up to noon on Saturdays, and that nothing will be contained in the code that will in any way interfere with private practice, or a dentist's technicians. The question of the one man laboratory was a serious problem, but I think this will be amply safeguarded. Drs. Wherry, Camalier, Cole and Brown spoke at the hearing. I wish that every member of the dental profession could have heard the appealing and forceful presentation by Dr. Wherry. It was a masterpiece and most favorably received.

The foregoing should present the strongest possible argument for stimulating a concerted campaign for increasing our membership.

October 21.

STATUS OF DENTAL LABORATORY CODE AS OF NOVEMBER 10

My latest information is that the proposed dental laboratory code has been revised to harmonize, as far as was considered feasible by the administrators, with the arguments presented at the hearing, on October 20, and has been referred to the various advisory

boards for consideration. The administrator will then prepare the official draft and submit it to representatives of the laboratories and others directly interested, for their comment, before it is finally presented to the President for his approval. All of this will require considerably more time than was anticipated at the time of the hearing.

HOMER C. BROWN, *Chairman*,
Committee on Legislation and Correlation,
American Dental Association.

NEWS

Practice by Foreigners in the United Kingdom: The action by the German Government to debar a section of the citizens from pursuing their callings in that country has caused an unflux into Great Britain of medical and dental students and practitioners, and drawn renewed attention to a problem of importance. From South Africa it is pointed out that, whilst their own regulations prescribe a three years' course of training at one of their schools before a German graduate can qualify for practice there, a single year may be sufficient in Great Britain to entitle to examination and registration, thus conferring the same privilege. This curious anomaly will no doubt receive attention from the authorities concerned, but meanwhile it is understood that applications are already being received from exiled persons who desire to practice their professions in this country or its colonies and dependencies. The French embargo upon foreigners referred to in the *Journal* of September 1, if not already operative elsewhere, seems not unlikely to be generally imposed, and, under these circumstances, the number of such aliens seeking entrance into parts of the British Empire may prove an unexpected tax upon the proverbial national hospitality. The total applications in England and Scotland now appears to have been less at the end of June than was estimated at a July Council meeting of the British Medical Association, but the Deans of medical and dental schools alike will no doubt bear the facts in mind when dealing with cases of this kind.—*Brit. D. J.*, Oct. 2, 1933.

The Indian Medical Act: By the Medical Act which recently passed the Indian Legislature, very much of the control of the profession in the Dependency passes from the General Medical Council to a local body constituted for that purpose, and some solution has been found of the difficult situation attending the home training of native practitioners. Whether the results will be the inauguration of suitable curricula and a standard of examination that will satisfy modern scientific views and developments has to be seen, but an attempt will no doubt be made to meet the requirements of reciprocity within the Empire. It is unfortunate that provision for the restriction of dental practice to properly qualified persons was not included in the Bill. The need for such a measure has been called attention to in these columns, and has lately been the subject of correspondence in the *Times* of India. Possibly it is intended to introduce supplementary legislative proposals for dealing with what is certainly a matter of urgent importance.—*Brit. D. J.*, Oct. 16, 1933.

Mr. Hutchinson Edinburgh Dean: Mr. A. C. W. Hutchinson, M.D.S., B.D.S., Manch., has been appointed Dean of Edinburgh Dental Hospital and School and teacher of clinical dental surgery with university professional status. Mr. Hutchinson is at present on the staff of the Manchester Dental Hospital and lecturer on dental prosthetics at Manchester University.—*D. Rec.*, October, 1933.

Mrs. Mellanby Honored: Sheffield University have decided to confer the honorary D. Sc. degree on Mrs. Mellanby in recognition of her research work on diet and dental disease.—*D. Mag. & Oral Topics*, July, 1933.

Sir Frank Colyer Honored: Sir Frank Colyer has been the recipient of many well-deserved honors. The latest is the bestowal upon him of the honorary degree of LL.D. by Bristol University, in connection with the centenary celebrations of their medical school.—*D. Rec.*, September, 1933.

Museum of Royal College: The enlarged, rearranged and redecorated section of the museum of the Royal College of Surgeons of England devoted to history displays a number of new exhibits. In a newly added room, mummies and objects illustrating the methods of preserving the dead are shown. The humerus and femur of Queen Berengaria, wife of Richard Coeur-de-Lion, have recently been bequeathed to the museum. They were discovered in Brittany, where she died, by Charles Stothard in 1819, in the remains of the abbey church of the convent which she founded. When found, the tomb was derelict and the place was used as a barn, but an inscription on slate recorded a previous removal of the bones of this "Queen of the

Angels" a century before. John Hunter's walking stick, a dark brown bamboo with silver band and crutch handle, has been presented by the family of the late Mr. W. Morrant Baker; and a gift of old bullet extractors and forceps has enabled a fine series of these tools from the 16th century onwards to be arranged. Thomas Clover's manuscript notes for his anesthetic apparatus and improved chloroform inhaler, presented by Dr. St. J. Dudley Buxton, make a further exhibit of great historic interest.—*D. Rec.*, September, 1933.

Sir Arthur Keith Resigns: The announcement that Sir Arthur Keith will shortly be relinquishing his post as curator of the Hunterian Museum of the Royal College of Surgeons will be received with widespread regret. During his long tenure the Museum has been greatly extended and has become the source of innumerable contributions to pathology in which Sir Arthur has played a prominent part. The Odontological Section of that museum, as the honorary curator, Sir Frank Colyer, would be the first to admit owes much to the unfailing support and encouragement of Sir Arthur Keith. But dental science is deeply in his debt in many other ways. The paper by Keith and Campion on the mechanism of the growth of the human face marked a new era in the scientific study of the factors concerned with the growth of the jaws. It is one of the most important contributions to orthodontics which has ever been made, and has been the starting point of many other investigations which have had an important bearing on the problem of malocclusion. But while Sir Arthur is leaving the Hunterian Museum, his services will not be lost for he is taking up the post of director of the surgical research laboratory at Downe House which has been founded by the munificence of Sir George Buckston Browne.—*New Zealand D. J.*, September, 1933.

Higher Dental Diploma (H.D.D.): The Royal College of Surgeons of Edinburgh grants a Higher Dental Diploma. Candidates, who must have devoted a year to study, or in practice as dentists, subsequent to obtaining an L.D.S. diploma accepted by the College, must pass an examination (written, oral, clinical and practical) in Dental Surgery, Anatomy, Pathology, Bacteriology, Prosthesis, Anaesthesia and Radiology.—*Brit. J. D. Sc. and Pros.*, September, 1933.

Practice by Foreigners in the French Republic: A law passed by the French Legislature last April, together with a supplementary decree more recently promulgated, would appear to affect materially the practice by foreign medical and dental practitioners in France and its Colonies. In future it is provided that no such persons may practice unless they hold a State Diploma and have become naturalized. It is true that the clause relating the naturalization may not be enforced where the practitioners of any nationality do not exceed in number the French doctors or dentists, as the case may be, in that particular country, but the application of this exemption seems likely to lead to obvious complications. In what directions, and to what extent, systems of reciprocity now in existence will be interfered with and need to be revised is not quite clear, but no doubt the possible effect of the amended legislation upon any arrangements now in force has had consideration. The restriction of practice to qualified persons only is of course generally approved and adopted, but its confinement to citizens of the country is not so universal.—*Brit. D. J.*, Sept. 1, 1933.

Naturalization and Parity: The clause demanding naturalization can be waived, says a recent Reuter message from Paris, if parity is established between the number of doctors and dentists of any one nation practicing in France, and the number of French doctors and dentists practicing in that country. But even so, the number of foreign practitioners will inevitably be reduced as there are many more of them in France and her colonies than there are French practitioners abroad. Under the new law, unless special modifications are made, the British Hospital in Paris may be forced to dismiss some of its staff and replace them by Frenchmen.—*D. Mag. & Oral Topics*, October, 1933.

Discovery of Vincent's Angina: An interesting historical point on the discovery of Vincent's Angina in the form of a note by Prof. H. Vincent, of the College of France, which appears in the *Military Surgeon* for July, makes it clear that the first complete account of this disease was made by Prof. Vincent. He first mentioned the condition in 1896 in the Annals of the Pasteur Institute, though he had observed it originally in 1892. Since then a series of studies from his pen from 1898 to 1901 dealt with its aetiology and bacteriology. The association

of *Bacillus fusiformis* with *Spirochaeta vincentii,* is, he states, unique in human pathology. But their union is not always constant or necessary. For that reason he termed the condition a fuso-spirochaetal parabiosis rather than a true symbiosis. After these publications and for nine years the priority of Professor Vincent's work was generally recognized and his name was attached to the condition. But in 1904, H. Plaut tried to take credit for the discovery; and later, other German writers have given him priority. In Germany the disease is usually termed Plaut-Vincent angina, but, according to Professor Vincent, this name is in no way justified on the ground of independent, but simultaneous discovery. It is, however, a fact that in 1894 Plaut described an ulcerative angina in which microscopically he found the "bacilli of Miller" and spirochaetes. But according to Vincent, this bacillus is really *Spirillum sputigenes* and in no way resembles *B. fusiformis.* Since the essential point of Vincent's work is the association of *B. fusiformis* with *S. vincentii,* he can legitimately claim to be the first investigator to work out fully the characters of the condition commonly known as Vincent's angina.—*Brit. D. J.,* Oct. 2, 1933.

Czechoslovakia Dental Change: Any physician may practice dentistry in Czechoslovakia. If he desires to use the title "specialist in dentistry" he must take a year's work post graduate in the state institute of dentistry. The law of 1920 forbids nonmedical practitioners, except those licensed before 1922, from engaging in dental practice. The nonmedical dentists are not graduates, but have learned their work as apprentices. The 1920 act was designed to place the practice of dentistry entirely in the hands of the medical profession, yet the medical men continue to engage apprentices, who are often permitted to do minor surgery. Agitation for the establishment of dental schools has not met with success, the medical fraternity being too strong and bitterly opposed to the innovation.—*J.A.M.A.*

Crawford W. Long, Physician-Pharmacist, Discoverer of Ether Anesthesia: Many articles have appeared in the *Journal of the American Pharmaceutical Association,* a number of greater length by the late Joseph Jacobs, an apprentice in the pharmacy of Dr. Long in Athens, Ga., on priority of the use of ether anesthesia in surgical operations. Reference is made at this time, because in an article of the public press, Dr. W. T. G. Morton was given the credit which rightly belongs to Dr. Long. The latter was the first one (1842) to use ether for producing surgical narcosis; the former was the first to demonstrate its use (1846) before a professional gathering. . . . Dr. Long performed several surgical operations prior to 1846, in Jefferson, Ga., two on James Venable. Physicians and surgeons of other countries acknowledged Dr. Long's priority in the use of ether anesthesia. When King Edward VII had recovered consciousness after an operation, he asked: "Who discovered anesthesia?" The answer which he received from the surgeon was: "Dr. Crawford Long, Your Majesty." Dr. Long graduated from the University of Georgia in 1835 (then Franklin College); he attended Transylvania University (Lexington, Ky.), and graduated from the University of Pennsylvania in 1839. After practicing in New York hospitals for eighteen months, he returned to Georgia (Jefferson), and in 1851 moved to Athens, where he practiced until his demise, June 16, 1878, at the age of 63 years.—*Am. Pharm. A., October, 1933.*

ANNOUNCEMENTS*

CALENDAR OF MEETINGS

American Dental Association, St. Paul, Minn., Aug. 6-10, 1934.

American Dental Society of Europe, Holland, August, 1934.

Dental Protective Association, Chicago, December 18.

Five State Post Graduate Clinic, Washington, D. C., March 19-21, 1934.

Greater New York December Meeting, New York City, December 4-8.

International Congress of Radiology, Zurich, Switzerland, July 24-31, 1934.

Society for Advancement of General Anesthesia in Dentistry, New York City, third Monday in February, April, October and December.

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June, inclusive.

STATE SOCIETIES

December

Ohio, at Columbus (4-6)

February

Minnesota, at St. Paul (21-23)

April

Alabama, at Montgomery (23-25)
Connecticut, at New London (18-20)
Kentucky, at Louisville (9-11)
Michigan, at Grand Rapids (9-11)
Montana, at Missoula (12-14)
New Jersey, at Atlantic City (25-27)
Tennessee, at Chattanooga (26-28)
Texas, at Fort Worth (24-26)

May

Arkansas, at Little Rock (14-16)
Illinois, at Springfield (8-10)
Indiana, at Indianapolis (21-23)
Iowa, at Cedar Rapids (1-3)
Maryland, at Baltimore (7-9)
Massachusetts, at Boston (7-9)
Nebraska, at Lincoln (21-24)
New York, at Buffalo (9-12)
South Dakota, at Mitchell (14-15)
Vermont, at Burlington (16-18)
West Virginia, at Clarksburg (21-23)

June

Southern California, at Los Angeles (4-6)
Georgia, at Atlanta (11-13)
New Hampshire, at Lake Sunapee (27-28)
North Carolina, at Wrightsville Beach (18-20)
Washington, at Tacoma (14-16)

STATE BOARD OF DENTAL EXAMINERS

California, at San Francisco, December 11. K. I. Nesbett, Secretary, State Bldg., Annex, San Francisco.

Colorado, at Denver, December 12. N. C. Gunter, Secretary, 610 Thatcher Bldg., Pueblo, Colo.

Delaware, at Wilmington, January 17-18. W. S. P. Coombs, Secretary, Middletown.

Minnesota, at Minneapolis, December 15-21. H. D. Aldrich, Secretary, Lowry Medical Arts Bldg., St. Paul.

North Dakota, at Fargo, January 9-12, R. E. Percy, Secretary, Mandan.

Rhode Island, at Providence, December 12-14. Albert L. Midgley, Secretary, 1108 Union Trust Bldg., Providence.

South Dakota, at Sioux Falls, January 4-6. John J. Berry, Secretary, Deadwood.

Texas, at Houston, December 11-15. J. T. Edwards, Secretary, Medical Arts Bldg., Fort Worth.

Wisconsin at Milwaukee, December 11-15. S. F. Donovan, Secretary, Tomah.

KENTUCKY STATE DENTAL ASSOCIATION

The sixty-fifth annual meeting of the Kentucky State Dental Association will be held at the Brown Hotel, Louisville, April 9-11.

J. H. FULLENWIDER, *Secretary*
Heyburn Bldg.
Louisville

*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

OHIO STATE DENTAL SOCIETY

The Ohio State Dental Society will hold its sixty-eighth annual meeting at the Neil House, Columbus, December 4-6.

EDWARD C. MILLS, *Secretary*
255 E. Broad St.
Columbus

TENNESSEE STATE DENTAL ASSOCIATION

The Tennessee State Dental Association will hold its sixty-seventh annual meeting, April 26-28, at the Patten Hotel, Chattanooga.

E. J. JUSTIS, *Secretary*
Exchange Bldg.
Memphis

ORGANIZED MEDICAL AND DENTAL PROFESSIONS OF THE CITY OF NEW YORK

The third annual meeting of the Organized Medical and Dental Professions of the City of New York will be held in cooperation with the Greater New York Meeting for Better Dentistry, December 4.

WILLIAM MCGILL BURNS

MINNESOTA STATE BOARD OF DENTAL EXAMINERS

The next regular meeting of the Minnesota State Board of Dental Examiners will be held at the College of Dentistry, University of Minnesota, Minneapolis, December 15-21. For application and further information, address

H. D. ALDRICH, *Secretary*
Lowry Medical Arts Bldg.
St. Paul

NORTH DAKOTA STATE BOARD OF DENTAL EXAMINERS

The next meeting of the North Dakota State Board of Dental Examiners will be held January 9-12, at the Gardiner Hotel, Fargo. Applications, with necessary fee, must be in the hands of the secretary at least ten days prior to date of examination. Address all communications for further particulars to

R. E. PERCY, *Secretary*
Mandan

SOUTH DAKOTA STATE BOARD OF DENTAL EXAMINERS

The next meeting of the South Dakota State Board of Dental Examiners will be held in the Carpenter Hotel, Sioux Falls, January 4-6. Applications with necessary fee must be in the hands of the secretary at least ten days prior to date of examination.

JOHN J. BERRY, *Secretary*
Deadwood

FIVE STATE POST GRADUATE CLINIC

The Five State Post Graduate Clinic (Delaware, Maryland, North Carolina, West Virginia, Virginia and District of Columbia) will be held, March 19-21, at the Shoreham Hotel, Washington, D. C.

MARSHALL E. BRUSHART
Publicity Chairman
Farragut Medical Bldg.
Washington, D. C.

JOINT MEETING OF MEDICAL AND DENTAL DEPARTMENTS OF MONTEFIORE HOSPITAL

There will be a joint meeting of the medical and dental departments of Montefiore Hospital, December 12, at 8:30 p.m.

D. TANCHESTER, *Chief*
Dental Department
Montefiore Hospital
New York City

DENTAL INTERNSHIPS AVAILABLE

There are available at the present time, in the Municipal Hospital, Hartford, Conn., two dental internships. These internships are for a period of one year. Practical training is afforded in all branches of dentistry and experience is afforded in the hospital and in the outpatient department, under the supervision of the dental staff.

RICHARD E. DUNNE,
Secretary of Staff
50 Farmington Ave.
Hartford, Conn.

ALPHA OMEGA FRATERNITY

The Alpha Omega Fraternity will hold its twenty-sixth annual convention at the Hotel New Yorker, December 23-25.

A. M. FLASCHNER
Supreme Scribe
419 Boylston St.
Boston, Mass.

DIRECTORY OF STATE SOCIETY OFFICERS AND DATES OF MEETING, 1934

ALABAMA

L. G. Pierson, President.....Selma
Hunter S. Allen, Secretary-Treasurer.....First Nat'l Bank Bldg., Birmingham
Date of next meeting: April 23-25, 1934.
Place of next meeting: Jeff Davis Hotel, Montgomery.

ARIZONA

William J. Johnson, President.....Luhrs Tower, Phoenix
Paul H. Bennett, Secretary-Treasurer.....907 Con. Bank Bldg., Tuscon
Date of next meeting:
Place of next meeting:

ARKANSAS

E. J. Mahoney, President.....Donaghey Bldg., Little Rock
I. M. Sternberg, Secretary-Treasurer....Merchants Nat'l Bank Bldg., Fort Smith
Date of next meeting: May 14-16, 1934.
Place of next meeting: Marion Hotel, Little Rock.

CALIFORNIA

Charles J. McCarthy, President.....166 Geary St., San Francisco
Frederick T. West, Secretary.....2180 Washington St., San Fancisco
John W. Leggett, Treasurer.....490 Post St., San Francisco
Date of next meeting: April 5-7, 1934.
Place of next meeting:

SOUTHERN CALIFORNIA

Charles M. Alderson, President.....815 Brockman Building, Los Angeles
Stanley Rice, Secretary.....1048 Roosevelt Building, Los Angeles
Fred B. Olds, Treasurer.....1152 Roosevelt Building, Los Angeles
Date of next meeting: June 4-6, 1934.
Place of next meeting: Biltmore Hotel, Los Angeles.

COLORADO

Joseph G. Ewers, President.....925 Republic Bldg., Denver
Bertram H. Downs, Secretary.....609 Ex. Nat'l Bank Bldg., Colorado Springs
Edward C. Carter, Treasurer.....962 Metropolitan Bldg., Denver
Date of meeting:
Place of meeting: Colorado Springs.

CONNECTICUT

J. Otis Miner, President.....48 Main St., New London
C. W. Vivian, Secretary-Treasurer.....58 Elbridge Road, New Britain
Date of next meeting: April 18-20, 1934.
Place of next meeting: Hotel Mohican, New London.

DELAWARE

D. J. Casey, President.....Medical Arts Bldg., Wilmington
M. Greenstein, Secretary.....Medical Arts Bldg., Wilmington
P. A. Traynor, Treasurer.....807 Washington St., Wilmington
Date of next meeting: January.
Place of next meeting: Wilmington Country Club, Wilmington.

DISTRICT OF COLUMBIA

W. W. Wyman, President.....724 Upshur Street, N. W., Washington
W. M. Simkins, Secretary-Treasurer.....720 Woodward Building, Washington
Date of meeting: June 12, 1934.
Place of meeting: Washington, D. C.

FLORIDA

E. L. Thompson, President.....Daytona Beach
R. D. Cummins, Secretary-Treasurer.....413 Equitable Bldg., St. Petersburg
Date of next meeting:
Place of next meeting:

GEORGIA

J. R. O'Neal, President.....Pelham
R. H. Murphy, Secretary.....Georgia Gas Bldg., Macon
Bryant K. Vann, Treasurer.....Candler Bldg., Atlanta
Date of next meeting: June 11-13, 1934.
Place of next meeting: Piedmont Hotel, Atlanta.

HAWAII

Joseph A. Pekelo, President.....471 S. Beretania St., Honolulu
J. K. Kahaleanu, Secretary-Treasurer.....471 S. Beretania St., Honolulu

IDAHO

R. A. Johnson, President.....Nampa
R. E. Blickenstaff, Secretary.....Nampa
L. E. Shaw, Treasurer.....Pocatello
Date of next meeting: June.
Place of next meeting:

ILLINOIS

W. I. McNeil, President.....59 E. Madison St., Chicago
B. H. Sherrard, Secretary.....300 Rock Island Bank Bldg., Rock Island
P. B. D. Idler, Treasurer.....55 E. Washington St., Chicago
Date of next meeting: May 8-10, 1934.
Place of next meeting: Springfield.

INDIANA

E. E. Voyles, President.....808 Odd Fellows Bldg., Indianapolis
C. L. Byers, Secretary.....2138 North Illinois St., Indianapolis
William Bogie, Treasurer.....214 Main St., Vincennes
Date of next meeting: May 21-23, 1934.
Place of next meeting: Claypool Hotel, Indianapolis.

IOWA

John J. Booth, President.....Marion
John Scholten, Secretary.....810 Dows Bldg., Cedar Rapids
H. J. Altfillisch, Treasurer.....722 Roshek Bldg., Dubuque
Date of next meeting: May 1-3, 1934.
Place of next meeting: Cedar Rapids.

KANSAS

Glenn E. Tilton, President.....917 Central Bldg., Wichita
Fred A. Richmond, Secretary.....305 Federal Reserve Life Bldg., Kansas City
W. T. Triplett, Treasurer.....Salina
Date of next meeting:
Place of next meeting:

KENTUCKY

C. W. Meguiar, President.....Franklin
J. H. Fullenwider, Secretary-Treasurer.....1101 Heyburn Bldg., Louisville
Date of next meeting: April 9-11, 1934.
Place of next meeting: Brown Hotel, Louisville.

LOUISIANA

Ralph L. Wood, President.....408 Bernhardt Bldg., Monroe
Julian S. Bernhard, Secretary.....417 Medical Arts Bldg., Shreveport
Oscar J. Ory, Treasurer.....Garyville
Date of next meeting:
Place of next meeting: Shreveport.

MAINE

Fred B. Wheaton, President.....Biddeford
George A. Phillips, Secretary.....31 Central St., Bangor
D. S. Roberts, Treasurer.....655 Congress St., Portland
Date of next meeting:
Place of next meeting:

MARYLAND

J. H. Ferguson, President.....Medical Arts Bldg., Baltimore
Walter L. Oggesen, Secretary.....St. Paul & 23rd Sts., Baltimore
Walter E. Green, Treasurer.....2958 W. North Ave., Baltimore
Date of next meeting: May 7-9, 1934.
Place of next meeting: Baltimore.

MASSACHUSETTS

Frank H. Dean, President.....311 Main St., Worcester
Philip E. Adams, Secretary.....236 Newbury St., Boston
Joseph T. Paul, Treasurer.....419 Boylston St., Boston
Date of next meeting: May 7-10, 1934.
Place of next meeting: Hotel Statler, Boston.

MICHIGAN

Ward Moore, President.....1426 G. R. Nat'l Bank Bldg., Grand Rapids
William R. Davis, Secretary.....Michigan Department of Health, Lansing
E. J. Chamberlain, Treasurer.....519 Ashton Bldg., Grand Rapids
Date of next meeting: April 9-11, 1934.
Place of next meeting: Grand Rapids.

MINNESOTA

C. K. Bird, President.....435 Hamm Bldg., St. Paul
L. M. Cruttenden, Secretary.....435 Hamm Bldg., St. Paul
A. R. Schmid, Treasurer.....Worthington
Date of next meeting: Feb. 21-23, 1934.
Place of next meeting: Auditorium, St. Paul.

MISSISSIPPI

A. S. Hopkins, President.....Gulfport
M. L. Jones, Secretary-Treasurer.....Meridian
Date of next meeting:
Place of next meeting: Jackson.

MISSOURI

Harry Allen, President.....Professional Bldg., Kansas City
C. W. Digges, Secretary.....Columbia
James F. McLellan, Treasurer.....Moberly
Date of next meeting:
Place of next meeting: Kansas City.

MONTANA

H. S. Fearn, President.....Bozeman
J. E. Buehler, Secretary-Treasurer.....409 Ford Bldg., Great Falls
Date of next meeting: April 12-14, 1934.
Place of next meeting: Missoula.

NEBRASKA

W. A. Cox, President.....715 Barker Bldg., Omaha
F. A. Pierson, Secretary.....1014 Federal Trust Bldg., Lincoln
G. L. Spencer, Treasurer.....Sharp Bldg., Lincoln
Date of next meeting: May 21-24, 1934.
Place of next meeting: Lincoln.

NEW HAMPSHIRE

A. F. Pottle, President.....Meredith
W. J. Moyles, Secretary.....1061 Elm St., Manchester
W. A. Young, Treasurer.....Concord
Date of next meeting: June 27-28, 1934.
Place of next meeting: Granliden Hotel, Lake Sunapee.

NEW JERSEY

R. E. Mulholland, President.....541 Broadway, Long Branch
F. K. Heazelton, Secretary.....223 East Hanover St., Trenton
George H. Griffith, Treasurer.....42 West State St., Trenton
Date of next meeting: April 25-27, 1934.
Place of next meeting: Ambassador Hotel, Atlantic City.

NEVADA

L. M. Nelson, President.....Medico-Dental Bldg., Reno
P. H. Phillips, Secretary-Treasurer.....Medico-Dental Bldg., Reno
Date of next meeting:
Place of next meeting:

NEW MEXICO

C. C. Robinson, President.....Albuquerque
Fred Muller, Secretary-Treasurer.....Taos
Date of next meeting:
Place of next meeting:

NEW YORK

J. G. Roberts, President.....471 Linwood Ave., Buffalo
A. P. Burkhart, Secretary.....57 East Genesee St., Auburn
George H. Butler, Treasurer.....Skaneateles
Date of next meeting: May 9-12, 1934.
Place of next meeting: Hotel Statler, Buffalo.

NORTH CAROLINA

Ernest A. Branch, President.....State Board of Health, Raleigh
D. L. Pridgen, Secretary-Treasurer.....Fayetteville
Date of next meeting: June 18-20, 1934.
Place of next meeting: Wrightsville Beach.

NORTH DAKOTA

George P. Jorgenson, President.....Grand Forks
I. W. Slingsby, Secretary.....55½ Broadway, Fargo
L. C. Schmitz, Treasurer.....Jamestown
Date of next meeting:
Place of next meeting: Grand Forks.

OKLAHOMA

E. E. Overmyer, President.....Surety Bldg., Muskogee
Francis J. Reichmann, Secretary.....1205 Medical Arts Bldg., Oklahoma City
C. B. Ball, Treasurer.....Frederick
Date of next meeting:
Place of next meeting:

OHIO

Alden J. Bush, President.....683 East Broad St., Columbus
Edward C. Mills, Secretary.....255 East Broad St., Columbus
Harry Cope, Treasurer.....327 East State St., Columbus
Date of next meeting: Dec. 4-6, 1933.
Place of next meeting: Columbus.

OKLAHOMA

A. C. Seids, President.....1200 N. Walker St., Oklahoma City
F. J. Reichmann, Secretary.....1205 Medical Arts Bldg., Oklahoma City
C. B. Ball, Treasurer.....Frederick
Date of next meeting:
Place of next meeting:

OREGON

J. Q. Young, President.....Medical-Dental Building, Portland
F. W. Hollister, Secretary-Treasurer.....Medical-Dental Building, Portland
Date of next meeting:
Place of next meeting:

PANAMA

Herbert Alden Doten, President.....Administration Bldg., Cristobal, C. Z.
Vern Prier, Secretary-Treasurer.....Masonic Temple Bldg., Cristobal, C. Z.

PENNSYLVANIA

H. C. Metz, President.....1201 Highland Bldg., Pittsburgh
C. W. Hagan, Secretary.....1011 Macon Avenue, Pittsburgh
J. H. Corcoran, Treasurer.....Scranton Life Bldg., Scranton
Date of next meeting:
Place of next meeting:

PUERTO RICO

Jose Vicente, President.....Box 100, San Juan
J. R. Hernandez Gonzales, Secretary.....Box 1361, San Juan
R. Fernandez Carballo, Treasurer.....Box 3291, Santruce

RHODE ISLAND

T. S. MacKnight, President.....119 Church St., Newport
Charles J. Smith, Secretary.....146 Westminister St., Providence
William J. McGovern, Treasurer.....830 Park Avenue, Auburn
Date of next meeting: January.
Place of next meeting: Biltmore Hotel, Providence.

SOUTH CAROLINA

C. O. Wells, President.....Spartanburg
T. C. Sparks, Secretary-Treasurer.....Medical Building, Columbia
Date of next meeting:
Place of next meeting: Spartanburg.

SOUTH DAKOTA

E. J. Schnaidt, President.....Menno
E. W. Elmen, Secretary.....611 Citizens Bldg., Sioux Falls
J. W. King, Treasurer.....Aberdeen
Date of next meeting: May 14-15, 1934.
Place of next meeting: Mitchell.

TENNESSEE

T. E. Braly, President.....Volunteer Bldg., Chattanooga
E. J. Justis, Secretary-Treasurer.....708 Exchange Bldg., Memphis
Date of next meeting: April 26-28, 1934.
Place of next meeting: Chattanooga.

TEXAS

W. P. Delafield, President.....Medical Arts Bldg., Dallas
J. G. Fife, Secretary-Treasurer.....Medical Arts Bldg., Dallas
Date of next meeting: April 24-26, 1934.
Place of next meeting: Fort Worth.

UTAH

E. A. Hunt, President.....Thompson Bldg., Salt Lake City
William Wood, Secretary-Treasurer.....First Nat'l Bank Bldg., Salt Lake City
Date of next meeting:
Place of next meeting:

VERMONT

L. C. Robinson, President ..... Morrisville
W. Fay Mann, Secretary ..... Barre
Thomas A. Norton, Treasurer ..... Rutland
Date of next meeting: May 16-18, 1934.
Place of next meeting: Burlington.

VIRGINIA

S. D. Kent, President ..... Danville
A. M. Wash, Secretary-Treasurer ..... Medical Arts Bldg., Richmond
Date of next meeting:
Place of next meeting:

WASHINGTON

C. E. Wilbur, President ..... Fidelity Bldg., Tacoma
A. W. Jeffrey, Secretary-Treasurer ..... 533 Medical-Dental Bldg., Seattle
Date of next meeting: June 14-16, 1934.
Place of next meeting: Tacoma.

WEST VIRGINIA

H. S. Barr, President ..... Charleston
J. E. Herbert, Secretary ..... Martinsburg
John S. Stone, Treasurer ..... Clarksburg
Date of next meeting: May 21-23, 1934.
Place of next meeting: Clarksburg.

WISCONSIN

R. W. Huegel, President ..... 703 Tenney Block, Madison
E. E. Parkinson, Secretary ..... 104 King Street, Madison
H. S. Huxtable, Treasurer ..... 126 High Street, Mineral Point
Date of next meeting:
Place of next meeting:

WYOMING

P. C. McNiff, President ..... Laramie
E. C. Andrew, Secretary ..... Cheyenne
Peter Appel, Jr., Treasurer ..... Cheyenne
Date of next meeting:
Place of next meeting:

LIBRARY BUREAU
AMERICAN DENTAL ASSOCIATION
OFFERS YOU
PAMPHLETS ON DENTAL ECONOMICS

Through the courtesy of the Julius Rosenwald Fund, copies are available of the studies entitled "Dental practice and income," by Maurice Leven and "Status of dentistry in our economic system," by Michael M. Davis. Dr. Herbert E. Phillips has likewise contributed copies for distribution of Thomas D. Eliot's "Trends in health care in relation to social-economic conditions." All of these studies may be obtained by writing to the Library Bureau of the American Dental Association, 212 E. Superior Street, Chicago, Illinois, and enclosing postage. Three cents postage is required for all three pamphlets or one and one-half cents for one or two of them. The three pamphlets together cover such topics as: Fees charged for various services, time spent in professional work, income from and expenses of dental practice, percentage of family income expended for dental care, ratio of dentists to population, etc.

ORTHODONTIA EDITORIAL REPRODUCED IN FORM SUITABLE FOR FRAMING

In response to numerous requests, the tribute to orthodontia which originally appeared as an editorial in THE JOURNAL has now been reprinted in a form suitable for framing, on parchment-like paper, measuring 10 by 15 inches. It is printed in brown and autographed in brown by the author. The initial letter is colored and may be obtained in green or red as preferred. (An appropriate Christmas remembrance for an orthodontist.) The cost of each copy is 50 cents. Send your order and remittance to the Library Bureau of the American Dental Association, 212 E. Superior St., Chicago, Ill.

WRITTEN INSTRUCTIONS FOR YOUR DENTURE PATIENTS

A booklet entitled "Your New Teeth," may be procured for distribution to your patients from the Library Bureau of the American Dental Association. This booklet is intended primarily for the patient who is wearing dentures for the first time. It enumerates some of the difficulties that may be encountered when one first wears dentures and offers suggestions as to how these difficulties may be overcome. There is also much of interest to the patient who has been wearing dentures, as information is given regarding the care, repair and rebasing of dentures. This information in this booklet was taken from the article entitled "Instructions for the Edentulous Patient," by B. L. Hooper, which was published in THE JOURNAL, February, 1932. The price of these booklets is: 25, $1.00; 50, $1.50; 100, $2.00. Kindly send remittance with order. A sample booklet will be sent on request.

Permission has been received from the U. S. Department of the Interior, Office of Education, to copy and distribute Circular No. 33 entitled "Dentistry." This circular discusses dentistry as a career and has information on compensations, census figures, progress in dentistry, the Dental Educational Council of America, state requirements for dentists, state board examinations, the dental schools, time required for training, courses of study, degrees, expenses, with estimated student budget, and tabulation of dental schools (1931), giving rating, required years, annual expense, enrollments (1928), graduates (1928) and percentages of failures on state board examinations (1928 and period of 1910-1928). This circular will be sent to those interested on receipt of six cents ($.06) to cover cost of postage.

Lists of books and package libraries available for circulation sent on request, or see the announcement sections of the August and September issues of THE JOURNAL.

OFFICERS AND TRUSTEES OF THE AMERICAN DENTAL ASSOCIATION

1933-1934

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Harry B. Pinney, Secretary, Ex-Officio.....212 E. Superior St., Chicago, Ill.
R. H. Volland, Treasurer, Ex-Officio....First Nat'l Bank Bldg., Iowa City, Iowa
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C. R. Lawrence, '36.....American Nat'l Bank Bldg., Enid, Okla.
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Thomas L. Grisamore, '35.....29 E. Madison St., Chicago, Ill.
E. G. Meisel, '35.....121 University Place, Pittsburgh, Pa.
Marcus L. Ward, '35.....1308 Cambridge Road, Ann Arbor, Mich.
Albert W. Crosby, '34.....215 Whitney Ave., New Haven, Conn.
C. E. Rudolph, '34.....905 Metropolitan Bank Bldg., Minneapolis, Minn.
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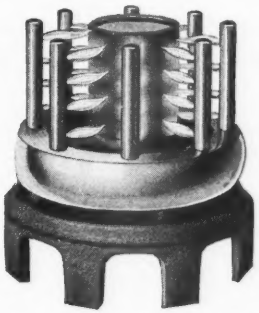
AN OUTSTANDING QUALITY PRODUCT. HIGHLY RECOMMENDED AND USED BY AN EVER INCREASING NUMBER OF DENTISTS. REASONABLY PRICED, A TRIAL WILL CONVINCE YOU.
ACCEPT NO SUBSTITUTES
— E.R.S. BREWSTER —
2730 HIGH ST. CHICAGO, ILL.

Thousands of Dentists
are using
The Torit Wax Eliminator
and we are sure they are all well pleased with it. Also used by many dental schools.



Note the numerous small flames providing an even and thorough heat. Ask your dealer about the
No. 46, for coal gas, or
No. 46-N, for natural gas, or
No. 39, for acetylene.
TORIT MANUFACTURING CO.
181 W. Kellogg Blvd., St. Paul, Minn.

We'll Be Your Santa Claus This Year

This year, more than ever, the EXTRA RETURNS that you get from us (because we buy direct from you, and never through traveling gold buyers) will prove mighty useful. Prompt returns made on all shipments.

Ship Scrap NOW—
Get Your Check Before Xmas!

We deal direct—
You get the benefit.

W·E·MOWREY CO.
SINCE 1898
1436 University Ave. St. Paul, Minn.

Classified Advertising Department

MISCELLANEOUS

EXTRA—Burs recut perfectly since 1906. Assorted—per gross $1.80, 3 gross $5.00. Sheun & Co., 6612 Sheridan Rd., Chicago, Ill. Testimonials on hand.

BURS RECUT—$2.00 per gross. Over three gross lots $1.75 per gross. Over ten years a bur stoner. Good work, prompt return. Ellis J. Witmer Bur Stoning Laboratory, Middlebury, Ind.

FOR SALE—Transactions of the American Dental Association for the years 1912, 1913, 1917, 1918, 1919, 1920, 1921, 1922, 1923, 1924, 1925, 1926, 1927, 1928, 1929, 1930, 1931, and 1932, at $1.00 per copy. As there are only a few available, orders will be filled as long as they last in the order in which they are received. Address A1499, care American Dental Association, 212 E. Superior St., Chicago, Ill.

NEW DENTAL EMBLEM

Solves the Christmas Gift Problem

Special notice to dentists: We now have a new **Dental Emblem** for your car. It fits above the license plates making it more easily seen. If you are a member of your local, state, or A.D.A. society, you should order your **Dental Emblem** now. Special rates available to dental societies. Literature and colors available free upon request. Order now. Dealer or direct $3.00

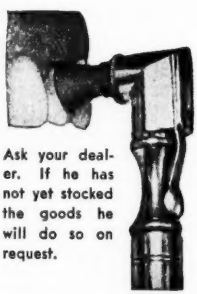
THE DENTAL EMBLEM CO.
P. O. Box 455-N **New Haven, Conn.**

Try SNAPON

THE NEW, IMPROVED POLISHER and the ANGLE MANDREL

You will like this highly efficient polisher which assures thorough, rapid prophylaxis with complete gentleness. Made of the finest rubber, it is flexible enough to adapt itself to almost every exposed tooth surface. It contains a metal cup which supports the rubber and holds the polisher securely on the mandrel. Price 60c a dozen.

Use Snapon Polishers with the angle mandrel to fit your handpiece. The flange on the polisher fits closely over the joint in the head of the angle handpiece and fully protects it. Price: 10c each, for straight handpiece, 5c.



Ask your dealer. If he has not yet stocked the goods he will do so on request.

YOUNG DENTAL MFG. CO. **4958 Suburban R. W. St. Louis, Missouri**

Make the Journal Your Buyers' Guide

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when Lips part

THE new, exclusive Color-Blending in New Trubyte matches natural teeth and blends with complexion color as no other artificial teeth can.

When lips part over New Trubyte, your reputation is enhanced.

NEW TRUBYTE

THE DENTISTS' SUPPLY COMPANY
of NEW YORK

Make the Journal Your Buyers' Guide

Christmas Greeting
to Our Advertisers

MAY WE PAUSE A MOMENT IN THE HUSTLE AND BUSTLE OF BUSINESS LIFE TO EXTEND A HEARTY GREETING, AND WILL YOU PAUSE WITH US TO LET THE SPIRIT OF THE YULETIDE PERMEATE SO DEEPLY THAT THE BEAUTIFUL SENTIMENT OF CHRISTMAS WILL EXTEND THROUGH THE YEAR TO COME.

Happy New Year to All

AMERICAN DENTAL ASSOCIATION

Widen the "Beneficial Circle"

ADULTS ENJOY *chewing gum*

. . . . . just as children do . .

Apply this test in your own family or among your patients. Chewing gum seems to afford a universal pleasure. Perhaps it is because it is such a *natural* pleasure — particularly so in this age of soft foods when the modern diet is so very deficient in chewing exercise. Again perhaps it is because chewing gum is such a simple, easy vent for excess energy.

N-44

This page is paid for by the National Association of Chewing Gum Manufacturers

There's Only One

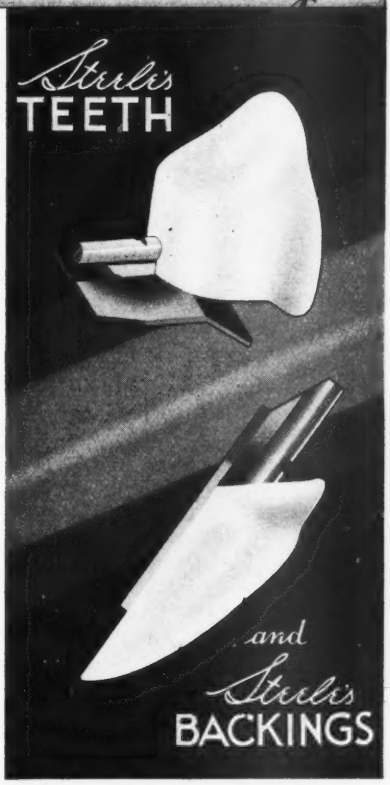
COMBINATION

That's Right

THE success of a bridge made with Steele's Facings or Trupontics depends greatly upon the strength and fit of the backings used.

The makers of Steele's Teeth would not care to guarantee against faulty bridgework where any other backing than Steele's has been used. All Steele's standard precious metal backings are stamped with the Trade-Mark *Steele's* under the end of the post.

WRITE FOR FREE
"UP TO DATE"
TECHNIC BOOK



ONCE USED
. . . . ALWAYS PREFERRED

THE COLUMBUS DENTAL MFG. CO., Columbus, Ohio, U.S.A.

The Profession says:
"Pleasing in results"

Patients say:
"Pleasing to use"

Lavoris purges mouth and throat through its unique and distinctive action in coagulating and flushing out fetid, germ-laden mucous deposits.

It produces marked stimulation of blood supply and promotes tissue tone and resistance.

Its daily use is decidedly advantageous to mouth health.

Trial package to the profession upon request

LAVORIS

THE LAVORIS COMPANY
904 NORTH THIRD STREET
MINNEAPOLIS, MINN.

LAVORIS CHEMICAL CO., LTD.
Toronto, Ont., Canada

Are You Creating Masterpieces of Modern Dentistry

like these? You can if you are using "The World's Best Alloy." There is no other alloy of this type made in which every particle of every metal is purified similar to the new and revolutionary Caulk method of electrolytic refinement.

Results: An amalgam with the highest crushing strength (58,000 lbs. per square inch), that has no initial contraction, with a high expansion average, 6 to 8 microns, and slight flow 1.5 to 2%. That's why there is universal demand for

Twentieth Century Alloy Improved

"The World's Best"

THE alloy which advances amalgam work to the highest peak of perfection. And to think that it is now obtainable at the lowest price T. C. Alloy has been sold in 25 years—

$1.80 an ounce in 5-ounce bottles.

$1.70 an ounce for two 5-ounce bottles.

Buy in 5-ounce bottles—SAVE!

CAULK THE L. D. CAULK CO.
MILFORD, DELAWARE

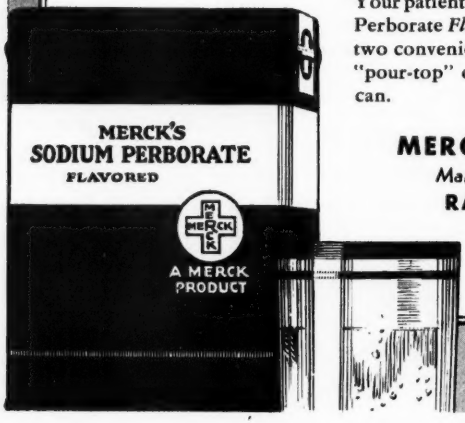
MERCK'S

SODIUM PERBORATE FLAVORED

FOR PYORRHEA

The regular use of Merck's Sodium Perborate *Flavored* helps to prevent bacterial activity in the periodontium. In active cases, it has a bactericidal effect upon pyogenic organisms, helping to prevent suppuration and mouth odors. In arrested cases, it is an excellent prophylactic against reinfection. It can be used effectively by rubbing or brushing on teeth and gums, or in solution for rinsing the mouth. Its available oxygen yield is 9%.

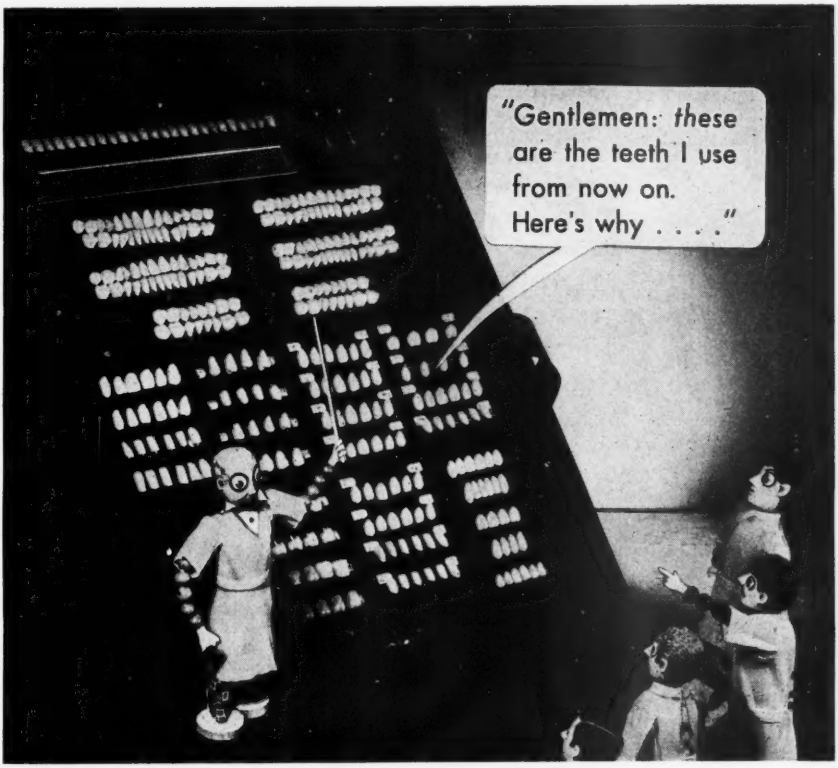
The daily use of Merck's Sodium Perborate *Flavored* is also recommended as a general oral prophylactic for cleaning the teeth and gums. It is effective, safe and pleasant to use. The peppermint flavor leaves a clean, refreshing feeling in the mouth.



Your patients can obtain Merck's Sodium Perborate *Flavored* at their druggists', in two convenient packages; the new 2-oz. "pour-top" can and the 4-oz. slip-cover can.

MERCK & CO. INC.
Manufacturing Chemists
RAHWAY, N. J.

ACCEPTED AMERICAN DENTAL ASSOCIATION



10 GOOD REASONS for using NUFORM TEETH

Complete range of Molds
Natural gradation of Colors
Improved Pin Retention
Natural Irregularities
Perfect Articulation
Natural Appearance
Superior Porcelain
Minimum Breakage
Thinner Anteriors
Cost no more

AT a recent meeting of a prominent Clinic Study Club, one of the member dentists used a Universal Demonstrator* (which he had borrowed for the occasion) to point out to his associates the unusual density of the porcelain which he had personally ground and polished; the exceptional pin construction; the fact that the pins can be bent without flaking the porcelain; the off center channel in Nuform Anterior Tube Teeth; the absence of any bulge in the Posterior Tube Teeth; the completeness of the line, etc.

It is because of just such interest as this that Nuform sales are showing continual gains. You're *missing something* if you don't give Nuform Teeth a fair trial.

**A small cabinet holding samples of all the different teeth made by the Universal Dental Company.*

UNIVERSAL DENTAL COMPANY

48th and BROWN STREETS, PHILA., PA.

ACID PHENOLSULPHONIC, LILLY
Caustic, Astringent, and Antiseptic

ANALGENTUM, LILLY
An Analgesic Ointment, Stimulating and Antiseptic

DENTAL LINIMENT, LILLY
Local Sedative for Pericementitis and Neuralgic Affections

DENTINOID (RADIOPACIC), LILLY
A Medicated Artificial Dentin for Protecting the Dental Pulp and Filling Canals

DESENSITIZING PASTE, LILLY
A Safe and Reliable Remedy for Hypersensitive Dentin

DEVITALIZING FIBER, LILLY
For Destruction of Dental Pulp

EUCALYPTOL COMPOUND, LILLY
Antiseptic

EUCAPERCHA COMPOUND, LILLY
For Filling Root Canals

EUROFORM PASTE, LILLY
Sedative and Mild Anesthetic

FORMOCRESOL, LILLY
Powerful Disinfectant for Gangrenous Pulp

LOCAL ANESTHETIC SOLUTION No. 2, LILLY
For Minor Operations

PROCAINE POINTS, LILLY
For Pressure Anesthesia

PYORRHEA ASTRINGENT, LILLY
Powerful Astringent, Stimulant, and Bactericide

REFRIGERANT COUNTERIRRITANT, LILLY
Counterirritant and Sedative

PHENOL COMPOUND, LILLY
Anodyne, Antiseptic, and Disinfectant

THYMOLIZED CALCIUM PHOSPHATE, LILLY
A Pulp-Capping and Filling for Small Root Canals

A pamphlet by Dr. Buckley, giving information on these preparations, will be sent to any dentist on request.

SUPPLIED THROUGH THE DRUG TRADE

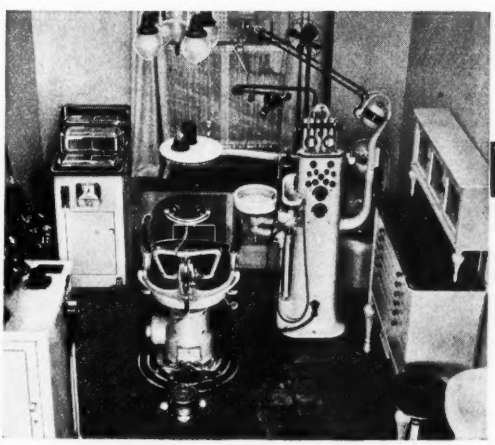
ELI LILLY AND COMPANY

INDIANAPOLIS, IND.

BRIDGE PARTY *Gossip* *Changed* HIS WHOLE CAREER

WHEN his wife returned from a bridge party and told him that she over-heard one of his former patients say that her "new dentist had such nice offices", it dawned on him that this might be one of the reasons why his practice was falling off.

So, instead of taking another flier in stocks, he decided to invest in his own business, where his investment would be under his own control. He modernized his office with Ritter Equipment—added a special Junior department—installed a Ritter X-Ray to find all the work that should be done—started to educate his patients to the importance of preventive dentistry. Today he will tell you that it was the most profitable investment he ever made. Ritter Dental Manufacturing Co., Inc., Rochester, N. Y.



Instead of being a liability, his offices are now his biggest asset for holding old patients and attracting new.

RITTER

Ritter Dental Manufacturing Co., Inc.,
Dept. A.D.A.-12, Rochester, N. Y.

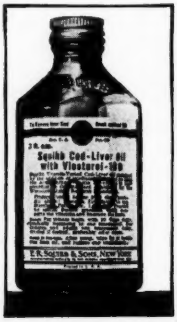
Please send me literature on following
- ☐ X-Ray
- ☐ Complete Office
- ☐ Junior Chair

Doctor.....

Address.....

Prescribing a "10 D" Oil for the first time?

Be sure it is SQUIBB'S!



Try this *richer* cod-liver oil fortified with Viosterol for growing children who need special help in tooth calcification.

And be sure they receive *all* the important vitamin values you prescribe. Insist on *Squibb's* cod-liver oil with Viosterol-10 D.

A special process protects the high potency of Squibb's "10 D" Oil. It is prepared under conditions which exclude oxygen to protect it against deterioration. Therefore, every dose supplies full vitamin value. It is less expensive than oils which have to be given in larger dosage because the vitamin content is less.

And Squibb's "10 D" is such an effective routine measure for the growing child! It contains *ten times* as much of the essential bone-and-tooth building factor—Vitamin D—as the standard cod-liver oil defined by the Wisconsin Alumni Research Foundation.

As prepared by Squibb, it also provides children with an abundance of Vitamin A.

Vitamin A helps them to grow and to keep their resistance high.

Every gram of Squibb's "10 D" Oil offers not less than 1,333 A.D.M.A. (133 Steenbock) units of Vitamin D and not less than 1250 U.S.P. units of Vitamin A.

Now—*every day* for growing children — Squibb's Cod-Liver Oil with Viosterol-10 D. Plain or with an agreeable Mint-Flavor. Squibb's is the *only* "10 D" Oil that comes flavored with mint.

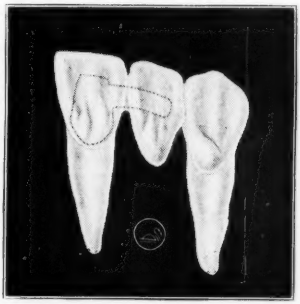
SQUIBB'S COD-LIVER OIL *with* VIOSTEROL 10 D

PLAIN
OR MINT-FLAVORED

Manufactured under license from the Wisconsin Alumni Research Foundation and acceptable to the Council on Dental Therapeutics of the American Dental Association

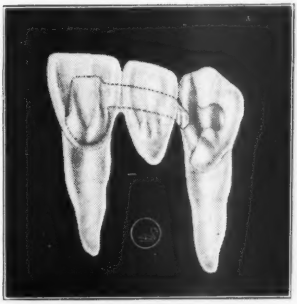
SWANN TORQUE RESISTING PORCELAIN JACKET CROWNS

SWANN Torque Resisting Porcelain Jacket Crowns are constructed with a scientifically designed, alloyed metal reinforcement which remains within the crown and prevents internal stress from being applied directly to the porcelain. To this metal coping a bar may be attached giving support to a dummy to make a two-tooth canti-lever bridge.



The first picture illustrates a bridge of this type having no metal exposed but the disto-lingual angle of the dummy may be built out in form of a fender which contacts the adjacent tooth in a manner which arrests rotation. The clean, highly glazed porcelain does not prevent the passage of floss and is easily kept free of debris.

The second picture illustrates a similar bridge but in this case the metal bar is extended to rest in a groove which has been cut in a proximal inlay.



In the third picture the bar forms an occlusal rest seated in an inlay. Any stress applied to the bar in this type of bridge is distributed between the inlay and the metal coping beneath the crown and does not produce internal torque upon the porcelain.

Modification of these bridges permit their adaptation to many cases.

These restorations may be procured from authorized laboratories. If your laboratory is not authorized to manufacture SWANN porcelain restorations, address J. P. Swann, Central Depot and Research Laboratory, 55 E. Washington St., Chicago, Ill., to obtain name of nearest authorized laboratory.

Journal Income Is Used to Protect Your Livelihood

S.S.WHITE 64 PACKAGES

64

KRYPTEX

6 regular sized bottles of powders, colors Nos. 1, 3, 5, 6, 9, 12 and 4 Liquids.

VALUE $16.00
PRICE 13.25
SAVING 2.75

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GERMICIDAL KRYPTEX

6 regular sized bottles of powders, colors Nos. 1, 3, 5, 6, 9, 12 and 4 Liquids.

VALUE $16.00
PRICE 13.25
SAVING 2.75

64

ZINC CEMENT

(Oxyphosphate)

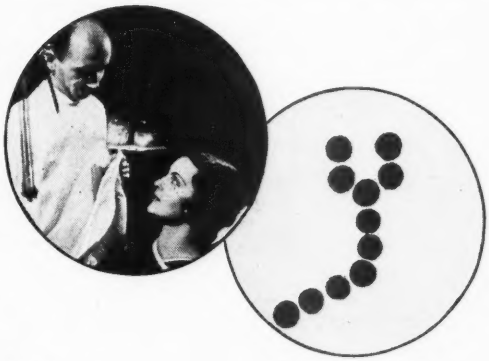
6 regular sized bottles of powders, colors Nos. 1, 2, 3, 4, 5, 6 and 4 Liquids.

VALUE $10.00
PRICE 8.00
SAVING 2.00

Prices effective in U. S. A.
FOR SALE AT DENTAL DEPOTS

Make The Journal Your Buyers' Guide

Pleasant for the Patient...



Yet powerfully Antiseptic

YOUR patients feel no smart or sting when you use Hexylresorcinol Solution S. T. 37. It does not burn their tongues, nor produce offensive chemical tastes or odors. It cannot injure delicate membranes.

Yet Hexylresorcinol Solution S. T. 37 does its work well. You can depend upon its thorough antiseptic qualities. It is stronger than carbolic acid in any usuable solution—kills vegetative organisms on less than 15 seconds' contact. Because of its low surface tension it spreads quickly over microscopic surface irregularities —penetrates crevices where bacteria breed.

• • •

Hexylresorcinol Solution S. T. 37 is entirely safe—non-toxic even if swallowed — may be recommended unhesitatingly to your patients for home use. Hexylresorcinol Solution S. T. 37 may be obtained at all druggists in the United States and Canada in 5-oz. bottles — 50¢, 12-oz. bottles — $1.00.

HEXYLRESORCINOL SOLUTION S.T.37

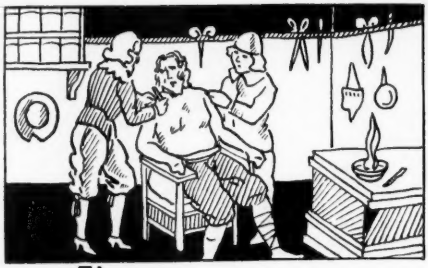
(Liquor Hexylresorcinolis 1:1000)

Sharp & Dohme

PHILADELPHIA BALTIMORE MONTREAL

Widen the "Beneficial Circle"

STERILIZATION BY HEAT



During the 16th and 17th centuries, most medicine was controlled by barber surgeons. The illustration, taken from an old painting, shows a typical operation performed by barber surgeons. Instruments were carefully heated before being applied to the patient. These barbers knew, empirically, that there was less likelihood of infection when heated instruments were used.

NRA MEMBER U.S. WE DO OUR PART

Novol 75 Anesthetic Solution is Isotonic—Isosmotic—Non-Hemolytic and Bacteriostatic.

All through the history of medicine and surgery, there are constant evidences of the knowledge that the application of heat to affected parts, to surgical instruments, etc., tended to prevent infection.

Not until the modern era, however, did learned men know that heat destroys bacterial invasions which cause infection. Today, more than ever, we know that no method of sterilization compares, in efficacy, with the *application of heat.*

• • • •

The puncturable diaphragm of the Metal Cap Anestube may be flamed, before use, thus preventing the possibility of carrying contamination into the solution, when the needle penetrates that diaphragm to establish communication with the contents of the container.

Use Metal Cap Anestubes—they may be flamed before use; *And—they contain Novol 75 Anesthetic solution.*

NOVOCOL CHEMICAL MFG., CO., INC.
2921-2923 ATLANTIC AVE., BROOKLYN, N.Y.
Makers of *Novol* Products
Oakland, Cal. Toronto, Canada

NOVOL *Metal-Cap* ANESTUBE

Make The Journal Your Buyers' Guide

What the American Dental Association *Offers You*

1. Protection and advancement of your profession and livelihood.
2. The Journal—giving you the best material available that is being published in the dental world.
3. Loan of Dental Books.
4. Loan of Package Libraries. (A collection of 20 to 30 articles on a specific dental subject. Over 250 subjects covered.)
5. Assistance in the preparation of talks and programs.
6. Loan or purchase of stereopticon slides and movie films.
7. Available selection of dental health material.
8. Protection against tariff increases.
9. Beneficial interpretation of tax provisions.
10. Other legislative benefits.
11. Group insurance saving.
12. Protection through Relief Fund, equivalent to insurance.
13. Dental Meetings. (Equivalent to a post-graduate course by leading authorities.)
14. Contact with leading health and community organizations.
15. Promotion of dental health education resulting in wider dissemination of dental facts to the public.
16. Indirect benefits that necessarily must be and which are carried on by organized effort.

***You insure your valuable possessions by taking out fire, burglary or other insurance. A membership in the American Dental Association insures your most valued asset*—YOUR LIVELIHOOD.**

•

Gingivitis and Controlled by Diet in

Dental disorders of 440 Mooseheart children respond to daily ingestion of fresh orange and lemon juice

Results in Brief:

GINGIVITIS

1st year (standard diet), incidence	74.9%
2nd year (standard diet + citrus fruit juices) .	12.4%
3rd year (standard diet, recheck period) . .	60.3%

DENTAL CARIES

1st year (standard diet), incidence	78.0%
2nd year (standard diet + citrus fruit juices) .	33.7%
3rd year (standard diet, recheck period) . .	83.4%

GROWTH (BOYS)

	Height Gain inches	Weight Gain lbs.
1st year (standard diet), av. gain, 13-yr. group	1.6	8
2nd year (standard diet + citrus fruit juices)	2.8	15
3rd year (standard diet, recheck period) . .	2.5	12½

NRA MEMBER U.S. WE DO OUR PART

"THE addition of a pint of orange juice and the juice of one lemon to a diet that is nearly adequate in all other respects supplies something that leads to a disappearance of most of the gingivitis and an arrest of about 50% of the dental caries."

This is one of the conclusions announced in "Diet and Dental Health," a monograph published by the University of Chicago Press. It reports the results of a three and one-half year study made at Mooseheart by The Sprague Memorial Institute at the University of Chicago.

American Diet Deficient

"The average American diet," the conclusions also state, "is adequate in calories but appears to be deficient in certain substances that are requisite to dental health. This dietary deficiency may be the ultimate cause of much of the gingivitis, pyorrhea and dental caries with which we are afflicted.

"Gingivitis and dental caries can occur in the majority of a large group of children who are receiving a quart of milk, one and one-half ounces of butter, a pound of vegetables, half a pound of fruit and nearly one egg a day. These foods do not, therefore, contain substances that are specifically antagonistic to gingivitis or dental caries.

Ample Citrus Fruit Juice Required

"Dental caries again becomes rampant and gingivitis redevelops in most of the cases when the citrus fruit intake is reduced to three ounces a day for one year. Three ounces is not enough.

"Children display a definite tendency toward the development of carious lesions which is nil or low in some cases and high in others. This

CALIFORNIA FRUIT GROWERS EXCHANGE...*Marketers of...*

Make The Journal Your Buyers' Guide

Dental Caries
3½-Year Clinical Study

Monograph contains many reproductions of the natural color photographs made to record all case histories

tendency can, perhaps, be ascribed to heredity. The administration of an adequate amount of citrus fruit juice to a diet that is nearly adequate in other respects reduces the intensity of the carious process; but does not completely remove the effects of the inherent tendency in all cases.

Rate of Growth Improved

"Orange and lemon juice contain something that acts as a growth stimulus to children."

How Study Was Begun

This study was the outgrowth of preliminary work by Dr. Milton T. Hanke, Associate Professor of Biochemistry in the Department of Pathology, and a member of The Sprague Memorial Institute at the University of Chicago, in collaboration with the Chicago Dental Research Club.

At the instance of this group and the Institute, the California Fruit Growers Exchange agreed to furnish fruit and additional funds to guarantee the completion of the research.

And for the monograph, the California Fruit Growers Exchange made available to the University of Chicago Press forty-eight costly color engravings and other plates. This makes it possible for the Special Advance ($1) Edition to contain the identical full-color illustrations to be used in the regular $4 edition.

Dentists: Send For Book

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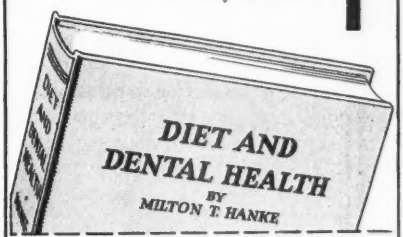

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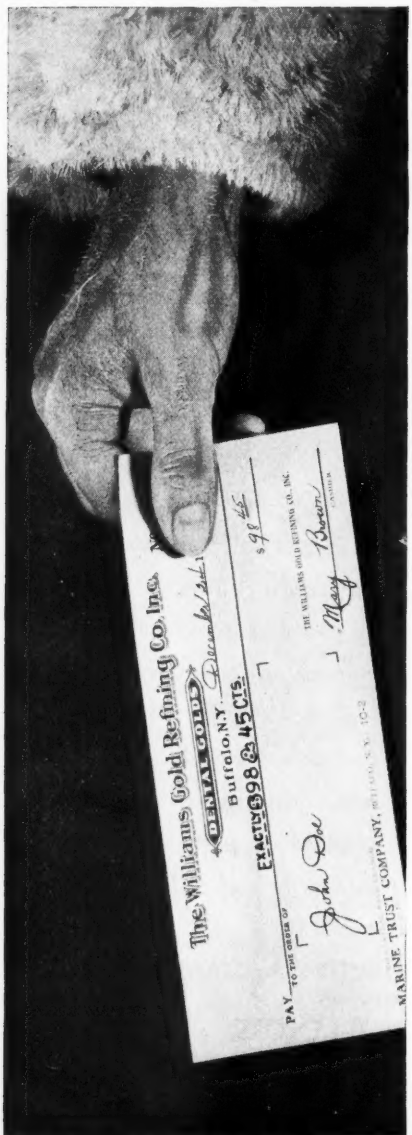

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The claim that Bond Bread is a rich* source of vitamin-D is accepted by the Committee on Foods of the American Medical Association. Vitamin-D is added to Bond Bread under the most rigid scientific supervision. The vitamin-D potency is, therefore, uniform and reliable. Best of all, the extra vitamin-D is absolutely free to the public.

**Bond Bread contains 95 Steenbock Vitamin-D units per pound.*

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1. More advertising in The Journal — *makes*
2. More funds available — *permitting*
3. More educational work to be done — *bringing*
4. More patients to the dentist — *causing*
5. More materials and equipment to be used — *creating*
6. More business for the dealer and manufacturer —*permitting*
7. More advertising in The Journal.

The Advertising Dollar!

IN order to picture how this would work, the following tabulation is tentatively set forth:

Minimum advertising revenue to be set aside and not included in amount to be considered in determining available funds for educational work	$50,000.00

(This represents the expected revenue if this plan was not operating.)

Excess of advertising revenue over the above amount would be split 50% to The Journal and 50% for lay educational work.

Assuming that the revenue from advertising was increased to $75,000.00 the following distribution could be made:

Revenue from advertising	$75,000.00
Deduct $50,000.00 reservation (explained above)	50,000.00
Balance	$25,000.00
50% of balance to be used for educational work	$12,500.00
50% of balance to cover cost of printing and handling of this additional advertising	12,500.00
	$25,000.00

NOTE: With the already existing facilities and organizational connections available to the Association, this lay educational fund would produce greater results than the amount shown would indicate. *The possibilities in this plan are limited only by the interest and support given it.*

You Can Do Your Part by Filling In the Coupon

5

I will support the above plan.

NAME..... ☐ Member A. D. A.
☐ Manufacturer
ADDRESS..... ☐ Dealer

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This Plan Has Been Reviewed and Approved by the Board of Trustees.

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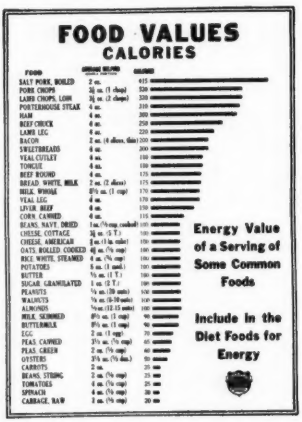

Charts That Aid In Teaching Patients

The normal diet is the best protection against dental caries.

To select such a diet intelligently, it is necessary to have information about the food constituents and their function in the body.

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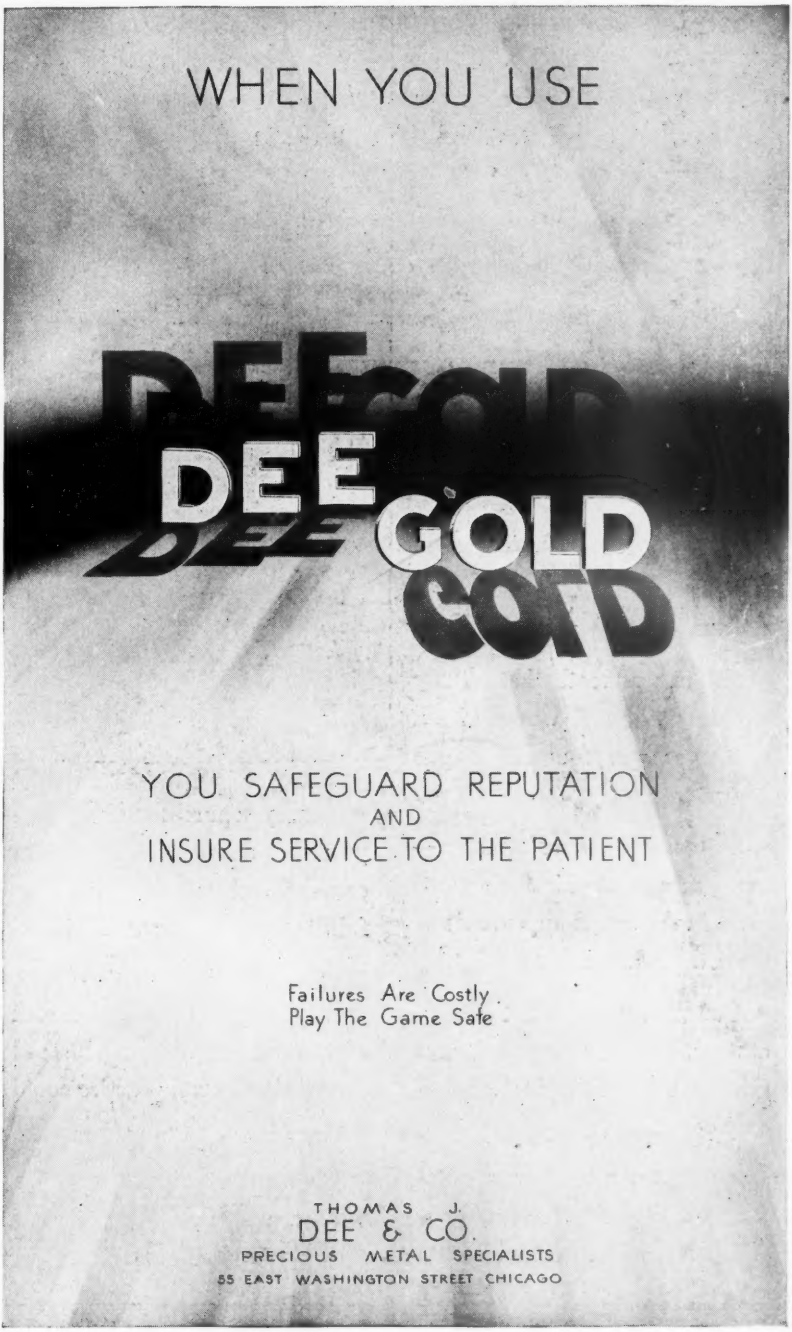
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